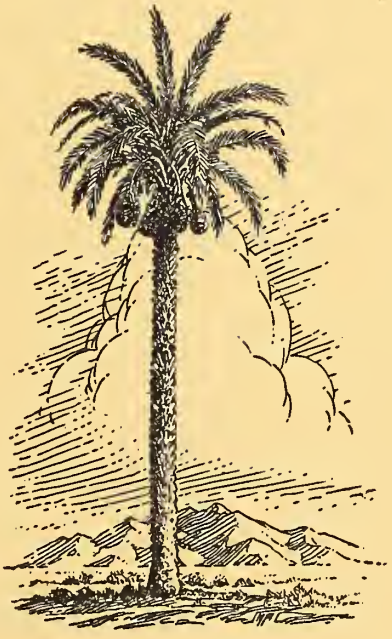
Report of

THIRTY-FIRST ANNUAL

DATE GROWERS' INSTITUTE

APRIL 24, 1954



HELD IN

COACHELLA VALLEY

CALIFORNIA

THIRTY-FIRST ANNUAL
DATE GROWERS' INSTITUTE

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VOLUME 31

CHAIRMAN MORNING SESSION
H. B. Richardson
Extension Viticulturist
University of California
Davis, California

CHAIRMAN AFTERNOON SESSION
R. M. Howie
Agricultural Commissioner
Riverside County, California

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Volume 31

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Coachella Valley, California

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The Date Growers' Institute is the official educational instrument of the date industry. Its goal is the dissemination of information on date growing, handling and marketing. This is its thirty-first year. Proceedings of each Institute have been published, and may be purchased in complete sets, or by separate copies. A full index will be mailed on request. Direct all inquiries to the Secretary.

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31st Annual Date Growers' Institute

April 24, 1954

Chairman, Morning Session: H. B. Richardson, Extension Viticulturist
University of California, Davis, California

Chairman, Afternoon Session: R. M. Howie, Agricultural Commissioner
Riverside County, California

INTRODUCTION

H. B. Richardson

Extension Viticulturist, University of California

It gives me great pleasure to act as Chairman of the Thirty-First Date Institute. I have tried over the years to attend as many of these Institutes as I could conveniently do so. My work has been changing these past few years and I find it increasingly difficult to meet with as many of you good date farmers in the Coachella Valley as I would like to.

But first I want to congratulate the growers and the Extension Service on the continuation of the Date Institute programs. There are times when it was felt that these meetings should be dispensed with. Changing patterns of grower interest in matters of education and research may have temporarily given the point of view that the Institute was no longer of service to the growers. In looking back through the thirty Institute publications that have been published I find names of old leadership, names of research people, programs on a wide variety of subjects which anyone can refer to. To me this is perhaps one of the biggest and most worthwhile undertakings that the industry has continued to support.

There is another point that has always interested me in working with the date growers of this Valley, and that is that the date growers may disagree violently on matters of date grades, and standards or methods of merchandising, etc., but have closed ranks and cooperated when matters of education and research were at stake. I have worked in the field of education and research for a good many years, not always, however, with dates, but I note that growers of other crops, like date growers, will sit down around the table and discuss matters of research and education for their own mutual benefit, without too many differences. This cooperativeness is a very good sign, and the Thirty-First Institute which is going on today is one of those many functions of education and research that I value so highly.

I'm not unmindful that the Chairman's job is to keep the meeting rolling, not to make long statements, but I do wish to bring up another couple of points that have been rather forcibly brought to my attention since leaving the Coachella Valley. One is the importance of organization on the part of farmers in the solution of their problems. Problems don't get solved unless somebody has the interest and fortitude to make their cases known. Good organizations, functioning in a clear-cut, substantial manner can lend materially to the stabilization of an industry. In times past, and no doubt in the future, the Date Institute will be called upon to aid in this important concept of problem solution. Perhaps also we need a little more faith in the minor fruit crops of California of which the date industry is one. As we see the importance of cotton and the new field corn developments in the State of California we perhaps lose our perspective when we begin to discuss many of our minor fruit crops. California has natural climatic advantages which are not found in other states. Many of these minor fruit crops would not succeed in any other area due to climatic, water, or other natural disadvantages. We need, in California, to exploit these crops to the fullest. Our population is steadily growing and there should be increased outlets for many of these crops properly handled and merchandised right within the confines of the State of California.

The date industry is fast reaching the half-century mark. Its problems are many. In the Coachella Valley the industry is close to great changes —more water, perhaps a changing climate, and more people. The Coachella Valley again may find the need for higher income crops which require more intensive cultivation, such as dates. If this is the case I am sure that through institutes of this kind the solutions to the problems will be found.

Again, I am very happy to be here and I hope that I will be able to attend the half-century mark when the Fiftieth Date Institute is held. It's not far distant.

RELATION OF DRY TEXTURE IN DEGLET NOOR DATES TO HIGH SPRING TEMPERATURE

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Dry-textured Deglet Noor dates grown in the Coachella Valley, Calif. differ from normal dates in several respects. They are hard and usually dull and somewhat wrinkled and often have whitish flesh in contrast with the translucent amber flesh of good dates. The pH of the flesh of dry-textured dates is lower than that of good ones. The pH of good dates is usually 6.0 or above and is never much below 6.0, but that of dry-textured dates may be below 5.5, and even as low as 5.0. Extremely poor-quality dates may have still lower pH values. Those with pH values above 5.5 are usually readily hydrated, but as the pH drops below this value hydration becomes increasingly difficult.

Dry-textured dates do not differ materially in total sugar content from good-textured ones, but usually in dry dates a larger portion of the sugar is in the form of sucrose than in dates of a more desirable texture (1, 2) and they contain less reducing sugars. The characteristic Deglet Noor flavor is present in fruits with pH values of 6.0 or higher, but it decreases as the pH decreases appreciably below this value. The flavor of those with intermediate pH values is by no means unpleasant. The moisture content of dry-textured dates is usually, but not necessarily, lower than that of the more desirable type.

No measurements by which it is possible to recognize potentially dry-textured dates during the growing season are known. Only when the dates ripen in the autumn can the dry-textured ones be recognized unless the injury in the spring is so severe as to make them misshapen.

Dry-textured dates make up more than 90 percent of the crop in very unfavorable years and less than 20 percent in very favorable ones. This large variation from season to season suggests an association between the dry texture and one or more aspects of the climate.

Table 1.—Classification of most years from 1930 to 1953 according to date texture with corresponding average maximum temperatures (°F.) for April 16 to April 30 and May 1 to 31 and heat units for April 16 to May 31, Indio, California

Date texture and year	Average maximum temperature		Heat units[1]
	April 16-30	May 1-31	April 16-May 31
Good texture:			
1930	90	88	60
1932	83	93	70
1933	80	90	64
1935	87	91	39
1941	85	95	99
1942	82	93	61
1944	80	92	23
1948	91	94	101
1953	87	88	10
Intermediate texture:			
1946	98	92	87
1949	94	92	79
1950	94	91	65
1951	83	94	124
Dry texture:			
1934	96	100	234
1936	93	98	156
1940	87	99	147
1943	96	96	154
1947	92	98	162
1952	84	102	221

1—Day-degrees above 95°.

The best available basis for classifying the texture of the date crops in the past years is the information obtained from growers and packers of many years' experience. Packing-house grades by themselves are inadequate because the quality of fruit bearing a given grade designation changes from year to year according to the average quality of the crop. Also, the number of classifications into which the dates are separated is changed occasionally. The classification given in table 1 was based largely on information obtained from the growers. The crops in 1930 and 1944 were outstanding because of the excellent quality including the fine texture of the fruit, whereas the dates of the 1934 and 1952 crops had the driest texture. Severe rain damage occurred in 1931, 1939, and 1945, and a severe freeze in January 1937 influenced the quality of the crop in that year and, to some extent, in 1938. The last five crops are omitted from the table.

The possible association of dry texture in Deglet Noor dates with several climatic characteristics has been investigated. Dry texture was not related to intensity or duration of periods of high humidity during the growing season, monthly mean or average monthly maximum temperatures from June through October, the highest temperature reached in any of those months, or the average monthly minimum temperatures from January through October.

The best relation between date texture and a single climatic characteristic was that between dry texture and high average maximum temperatures in the second half of April or in May. Dry-textured-date crops were produced in seasons with high average maximum temperatures in either or both of these portions of spring, and crops of exceptionally good-textured dates were associated with low average maximum temperatures in both. This relation is brought out by the temperatures given in table 1.

Dry-textured-date crops may be associated with short periods of intense heat or with protracted periods of moderately high temperatures in April or May. Examples are found in 1947, when a temperature of 119 degrees F. occurred on May 1, but 100 degrees was reached on only 9 days in the entire month, and in 1952, when

the highest temperature in May was only 109 degrees, but a maximum of 100 degrees or higher was reached on 21 days in the month. The texture of the dates in both years was characterized by extreme dryness.

The dates produced in 1946 were intermediate in texture and were probably damaged somewhat by the high temperatures that prevailed in the second half of April, the warmest such period in the years studied. The fact that the crops in 1949 and 1950 were not of top quality may also be related to the high average maximum temperatures in the second half of April. From the average maximum temperatures in April and May 1951, a rather high-quality crop could have been expected that year. However, the temperature rose to 116 degrees F. on May 27 and to 113 on May 26 and May 28. The only other year within the period studied in which so high a May temperature was recorded at Indio was 1947, a year in which the texture of the dates was generally dry.

The relation between flesh texture and temperature can be expressed rather effectively in heat units as given in table 1. Good-textured dates were produced in years when the heat units did not exceed 101, whereas dry-textured dates were produced in years when the heat units totaled 147 to 234. The texture of the dates within each classification in table 1 was not necessarily related exactly to the number of heat units; other unidentified factors were involved. For example, the dates produced in 1953 had better average texture than those produced in 1948, but not as good as those produced in 1944. The number of heat units in 1946, 1949, and 1950 do not account for the intermediate texture of the dates, but high temperature in the second half of April may have been conducive to the development of moderately dry texture.

Dry texture in each season applies only to the general or average condition in the Coachella Valley. The association of texture with certain climatic features must not be interpreted to mean that other factors are not important. In fact, they are extremely important, for in years when dates were of average good texture, e.g., 1953, some gardens produced crops predominantly dry in texture. Similarly, in years when the average date texture was dry, e.g., 1952, some dates of excellent quality were produced. Undoubtedly date texture is influenced by such factors as characteristics of the soil and the irrigation water, soil management, fertilization practices, and bunch management. Additional factors not yet identified may have influences. Local differences in temperature may be associated with some of the variability in texture, but data bearing on this possibility are not available.

The possibility that young dates may be injured by high temperatures in April and May is supported by laboratory experiments in which fruits picked at weekly intervals from May 6 to June 9, 1953, were held at 104 and 113 degrees F. for as long as 2 days and at 122 and 131 degrees for as long as 8 hours. Additional pickings were made at 2-week intervals until the latter part of July. The first visible evidence of injury was darkening of the seeds. More severe injury produced progressively increasing darkening of the flesh, and dulling and finally browning of the skin. The sensitivity of young dates to heat injury remained high until the latter part of May, but decreased noticeably between May 25 and June 2 and continued to decrease thereafter. Time of blooming undoubtedly should be taken into account in attempting to establish the period of greatest sensitivity of dates to high temperatures, but extensive accurate information on the time of peak bloom is not available.

The relation described between texture of date fruit and temperature was developed for the Deglet Noor variety only. Most other varieties, especially the soft, or invert sugar, type, do not appear to be subject to such large variations in texture from year to year as the Deglet Noor and no attempt has been made to relate fruit texture of these varieties to climatic characteristics.

SUMMARY

Dry-textured Deglet Noor dates grown in the Coachella Valley, Calif., are harder and duller than good-textured ones. The flesh is often whitish and has a lower pH, lower reducing sugar content, higher sucrose content, and usually a lower moisture content than the flesh of good-textured dates. The amount of dry-textured fruit in a crop varies from more than 90 percent in unfavorable years to less than 20 percent in favorable ones. A high percentage of dry-textured fruit was produced in years when high temperatures occurred in the second half of April or May. Dates with good texture were produced in years when the number of day-degrees over 95 degrees F. between April 16 and May 31 did not exceed 101 and dry-textured dates were produced in years when the day-degrees totalled from 147 to 234. The dry texture of date flesh was not consistently related to any characteristic of the climate other than high temperatures in the portion of the spring mentioned. Laboratory experiments supported field observations that after the latter part of May the growing dates developed increasing tolerance to high temperatures. The association of dry-textured dates with high spring temperatures has been developed for the Deglet Noor variety only. Any possible similar relation for other varieties has yet to be uncovered.

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BACTERIOLOGICAL STUDIES ON DATES

By Habib W. Hadayah[1]
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The possible survival of disease-producing bacteria on dates is of interest because at least one outbreak of severe colitis has been traced to packaged dates, as cited by Clague and Fellers (1). In two tests these authors found that "Iraq dates which were artificially heavily inoculated with *Bacterium coli* survived 17 to 20 days at room temperatures. The Iraq dates contained an average of 860 microorganisms per gram. The bacteria were mainly aerobic spore forming types." They concluded that, "pasteurization renders packaged dates free from the usual pathogenic and spoilage types of microorganisms and insects and improves the appearance and flavor. The operation is commercially feasible."

In another paper Fellers (2) reported that of the 79 samples of dried fruits examined, only 8 contained lactose fermenting bacteria. None was identified as *Escherichia coli*. He found that where dates were liberally inoculated with *Escherichia coli* and stored at laboratory temperatures, the bacteria always died out within 30 days after inoculation."

The experiments described herein were undertaken to determine how long a typical bacterium will survive under temperatures closely approximating those of date growing regions.

1. *This report is a summary of work done in the Food Technology Department at the University of Massachusetts, Amherst, Massachusetts.*

Further experiments were conducted by the writer with the bacterium, *Escherichia coli,* which was chosen because when it is found in foods it is considered an indication of fecal contamination and the probable presence of pathogenic bacteria. Three lots of dates were used in the experiments: Iraq packaged dates, Iraq bulk dates, and California packaged dates. Samples of the three lots of dates were examined bacteriologically with the result that no bacteria were isolated. Then inoculation tests were made as follows:

FIRST INOCULATIONS

Procedure

Inoculum was prepared by adding 10 ml. of *E. coli* broth to 1000 ml. of nutrient broth and incubating for 24 hours at 37° C. From the resulting suspension, a 100 ml. portion was set aside and the remainder was divided into three equal portions, one for each sample of dates. Control cultures were made with Endo's and Desoxycholate agar streak plates to determine the presence of *E. coli* in the inoculum.

Three different methods of inoculation were used, with samples of 20 dates from each lot of fruit. (1) Two loopfuls of inoculum were introduced into the center of each date. (2) The dates were immersed in the inoculum, using aseptic technique. (3) After washing the hands thoroughly with soap and water and disinfecting with bichloride of mercury, solution, 1:500, the fingers were dipped into the inoculum and the dates subsequently handled. After each inoculation the dry dates (moisture content probably 17%) were transferred to sterile petri dishes. All samples were incubated at 37° C.

Results

Control plates showed the presence of *E. coli* in typical colony formation after 24 hours incubation.

After 8 days, three dates from each petri dish were removed aseptically and each group placed in individual dilution bottles containing 90 ml. of sterile water. These were shaken until the dates were well broken up. Cultures in duplicates from each suspension were made with Endo's and Desoxycholate agar streak plates which were incubated at 37° C. for 24 hours. No growth on any of the plates could be detected after 24 hours incubation, nor did *E. coli* colonies develop after continued incubation at room temperature for 48 hours.

SECOND INOCULATIONS

Procedure

In the second inoculations samples from only two lots of dates were used—the packaged and bulk dates from Iraq. Inoculations were limited to momentary immersion and handling. The procedure was similar to that used in the first inoculations except that samples of 40 dates were taken and, after inoculation, these were divided into halves, one set for 37° C. incubation, and the other for room temperature incubation.

Results

Control plates showed the presence of *E. coli* in typical colony formation after 24 hours.

Samples of inoculated fruit taken and cultured at 24 hour intervals showed the maximum length of survival of *E. coli* on both packaged and bulk dates to be: (A) 3 days from immersion inoculation and 2 days from handling inoculation at 37° C. and (B) 12 days from immersion inoculation and 10 days from handling inoculation at room temperature.

DISCUSSION

The survival time of *E. coli* on dates seems to be influenced by temperature. At high temperatures, it is possible that the rate of plasmolysis due to the high percentage of sugar (75-78%) contained in dates, is increased, possibly accounting for the shorter survival time of *E. coli* at 37° C. than at room temperature. (65-70° F.)

In Iraq, the normal maximum temperatures at harvesting time are 100° F. or higher. This is a little more than 37° C., used in this work, and coliform organisms being deposited on the dates at time of harvesting would probably survive only a very short time, possibly not more than two days.

Furthermore, the shipping time required for "Iraq" dates to reach most of the centers of import is far greater than the survival time of coliform on dates under similar conditions and, if in handling the dates become contaminated, the organisms in all probability would not outlive these conditions.

Consumers can feel assured, therefore, that dates can safely be included in the diet from a public health point of view. Conditions of temperature and shipping time in Iraq and southern California are such that transmission of disease by contaminated dates is highly unlikely.

SUMMARY

From samples of Iraq packaged and bulk dates and from California packaged dates, cultures made according to bacteriological technics failed to show the presence of coliform organisms. Inoculation of dates with a typical bacterium, *Escherichia coli,* by two methods, immersion and handling, and subsequent bacteriological cultures showed a maximum survival of this organism of 3 days at 37° C. and 12 days at room temperature.

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THE DIFFERENTIATION, DEVELOPMENT AND ANATOMY OF THE AXILLARY BUD, INFLORESCENCE AND OFFSHOOT IN THE DATE PALM

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In the axil of each leaf on a date palm is a broadly, triangular, wide, thin bud known as an axillary bud. This bud may differentiate into an offshoot, into indeterminate types of structures that may contain imperfect flower parts or leaf and flower parts, into an inflorescence or may die (Figure 1). Little is known of these phenomenea because differentiating buds are located near the heart of the palm so that it is necessary to kill the parent palm to study their development.

An incomplete report upon bud growth (1) revealed that it is continuous throughout the year, that inflorescences differentiate from an unbroken series of buds and that the inflorescences developing from younger, smaller buds near the center of the palm are larger than those developing from larger older buds.

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(1) *This study was initiated by the late D. W. Albert in 1931. The writer wishes to acknowledge the assistance of Dr. S. H. Cameron, Professor of Subtropical Horticulture at U.C.L.A., who urged the continuation of the project and assisted in further planning of the work and interpretation of the data; also, Dr. F. Murray Scott of the Botany Department at U.C.L.A. who directed the anatomical studies, and Dr. J. R. Furr of the U. S. Date Gardens at Indio, California who made possible defoliation experiments and provided the date offshoots.*

Figure 1. A-D axillary buds about five years old subtended by mature functioning leaves obtained from large fruiting palms. A & C mature buds, September 18. B—dead bud on October 8, and D—recently differentiated inflorescence on November 3 which occurred on buds similar to A & C. E—H materials obtained from large 70 lb. offshoots in January. E & G—young buds subtended by slowly enlarging leaves about one inch long. F—incomplete spadix like structure and G—young offshoot which differentiated from buds similar to E and G.

METHODS AND MATERIALS

In 1931-1932 mature, fruiting Rhars palms, which were planted in 1904 at the University of Arizona Date Garden near Tempe, Arizona, were dissected on May 14, June 25, August 7, September 17, November 2, December 21, February 1, March 7 and May 5 (1) to observe normal bud development. In 1940-1941 similar Rhars palms were removed in May, July, September and February to observe the effects of defoliation and fruiting upon bud differentiation into an inflorescence. In 1942 five Rhars palms were dissected between September 18 and November 3 to determine more accurately the time when inflorescence primordia first appear. During 1948, 23 offshoots produced at the U.S.D.A. Date Garden near Indio, California, were dissected in January, May and October to observe the development of small offshoot primordia.

Buds, small inflorescences, small offshoots, leaf tissue and shoot apicies were preserved in killing solution and subsequently sectioned and stained for anatomical studies. The position and age of leaves with respect to the differentiation of the axillary bud was noted. In mature palms leaves were numbered upward and downward from the one subtending the uppermost bunch of dates or inflorescence. In offshots the spike leaf was similarly used as a reference point.

DIFFERENTIATION, DEVELOPMENT AND ANATOMY OF THE AXILLARY BUD

Dissection of large mature fruiting palms at different times during the year indicate that from 85 to 104 leaves are present centrad of the first leaf above the uppermost inflorescence (Figure 2). Since an average of 22 leaves had been produced in previous years on the palms studied, it is evident that leaves are differentiated from the shoot apex about four years prior to the time the pinnea unfold and the leaf becomes functional. The axillary bud differentiates at the time the leaf primordia is formed (Leaf 104). A small group of cells at the center of the base of the young leaf first divide to form a flattened cone. Subsequent cell division then occurs to form a wide, thin base. This bud tissue differentiates chiefly from the tissues of the fiber sheath of the adjacent younger leaf. During the first growth year the bud assumes its typical shape (Leaf 104 to Leaf 84). A group of meristematic cells near the bud apex divide to provide the parenchyma cells of the bud. The provascular system develops its typical form, the principal part of which consists of a group of strands in the center of the bud in a funnel like pattern. These strands differentiate into the developing inflorescence or offshoot. In the succeeding three years (Leaf 84 to 21) the bud slowly enlarges with no significant changes in its external shape or internal structure. During this interval the subtending leaf first enlarges very slowly and

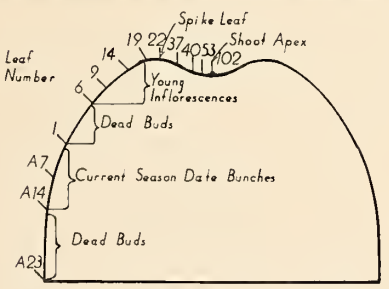

Figure 2. Diagramatic longisection through the upper part of a palm trunk showing method of leaf and bud numbering and condition of bud development: Bud 1 is first bud above current season date bunches; buds6 — 19 are recently differentiated inflorescences; buds 20—102 are undifferentiated. The spike leaf subtends bud 22, bud 104 is the youngest bud adjacent to the shoot apex. An average of 22 new buds develop each year.

then during the final six month period it elongates rapidly to its maximum size after which the pinnae unfold and the leaf becomes functional (Leaf 21). At this time the buds are from five to seven millimeters in length.

TIME OF APPEARANCE OF FLOWER PRIMORDIA

In the first examination of bud differentiation (1931) it was found that floral parts were not present on September 17 and were evident on November 2. In 1942 four palms were dissected between September 18 and November 3 (Table 1). Floral parts were not found until November 3. At this time the development was almost precisely the same as that observed 11 years previously on November 2. The larger size buds 6 to 19 and buds 1 to 21 on palms dissected on October 8 and 20, respectively, suggests that these buds were beginning to differentiate. However, anatomical observations of these buds failed to reveal any indication of the differentiation of floral parts. It may be concluded that differentiation of floral parts occurs rapidly between October 20 and November 3. The similarity in the size and anatomical development of the small inflorescences indicates that differentiation of the entire series of buds occurs simultaneously. On average fruiting palms inflorescences differentiate from buds subtended by leaves that become functional (pinnae unfold and become green) between April 1 and November 1 immediately preceding differentiation.

DEVELOPMENT AND ANATOMY OF SPADICES AND FLORAL PARTS

A differential rate of growth takes place as the spadices gradually enlarge during November and December. The uppermost ones, which develop from the younger buds subtended by leaves which became functional during September and October, grow most rapidly. This produces mature spadices which decrease in size basipetally on the palms. Growth of the spadices is rather uniform and slow until early February when a period of rapid growth begins. Growth then continues at an accelerated rate until the inflorescences mature and the spadices open during April.

On November 3 all of the inflorescence spike primordia are present, but no development of the inflorescence axis is evident. Each strand is about one millimeter in length and the presence of a portion of the flowers on the spike is indicated by small groups of meristematic cells (Figure

A B C

Figure 3. Longisections through inflorescences showing spike and floral development. A, November 2, early stage in the differentiation of the spike. The darkly stained areas on the sides of the spikes are flower primordia. B, December 21, spike development is complete, all floral meristems have differentiated and a bract subtends each potential flower. The tapered position of the spikes show that the axis of the inflorescence is being formed. C, February 1, mid development stage of floral parts showing differentiation of sepals, petals, rudimentary stamens and carpels. The abscission layer has been initiated.

Table 1.—Length and type of development of buds in mature fruiting Rhars palms

Bud No.	Sept. 18	Oct. 8	Oct. 20	Nov. 3
1	D	D	15.0 b	D
2	D	D	14.0 b	D
3	11.0 r	D	14.0 b	D
4	11.0 r	10.5 r	12.0 b	D
5	11.5 b	12.0 r	11.5 b	12.5 r
6	11.5 b	13.0 b	12.0 b	17.0 I
9	11.0 b	12.5 b	12.5 b	21.0 I
12	10.0 b	11.2 b	12.0 b	22.0 I
15	9.5 b	9.5 b	11.0 b	20.0 I
17	8.0 b*	8.5 b	11.0 b	21.0 I
18	7.5 b	7.0 b	10.0 b	20.0 I
19	7.5 b	8.0 b*	9.5 b	20.0 I
20	5.5 b	6.0 b	8.0 b	20.0 I
21	5.0 b	6.0 b	9.0 b*	20.0 I
22	4.5 b	5.5 b	7.0 b	7.0 b*

D—bud dead; r—bud growth retarded, probably will die; b—bud normal, undifferentiated; I—bud differentiated into inflorescence; *—bud subtended by spike leaf.

Intervening buds not indicated in the table are intermediate in size and have the same development as adjacent buds. Length of buds reported in millimeters.

3A). Procambial strands are present. By December 21 the typical shape of the spadix develops and initial growth of the inflorescence axis is evident (Figue 3B). The full compliment of flower primordia are present on the fully differentiated spike. A large bract partially encloses the flower primordium but the individual flower parts are not differentiated. On February 1 a marked difference in floral development exists between the largest and the smallest inflorescence. On the smaller ones (estimated to be mature on May 1) primordial flower parts consisting of three sepals, three petals, three carpels and six small stamens are present (Figure 3C). These are partially enclosed in a small bract. On the larger inflorescences (estimated to be mature on March 25) the floral parts are more mature. The abscission layer is present and spiral lignification of the xylem elements in the vascular strands is evident. The carpels are large and upright, stamen development is restricted and the bract subtends only the base of the flower.

EFFECT OF LEAF AND FRUIT REMOVAL UPON INFLORESCENCE DIFFERENTIATION

It has been shown that evidence of flower parts is found about four years after the bud is formed at the shoot apex. To determine the factors involved in differentiation two experiments were conducted. In Experiment 1, which was conducted in 1941-42, mature Rhars palms were treated as follows: (a) four palms were fruited normally with ten thinned bunches so that the leaf-bunch ratio was about 7:1; (B) three palms had all inflorescences removed in April and all the leaves were left on;

Table 2.—Effect of leaf and fruit removal upon the development of leaves, buds and inflorescences

	Treatment A Control	B Defruited	C Defoliated
No. bunches fruited	10	0	16
No. leaves Apr. 15	61	71	6
No. leaves developed Apr. 15-Feb. 15	15	19	13
Ave. weight of leaf in Feb. (lbs.)	9.9	11.2	8.6
Ave. length buds No. 1-20 in Sept.	7.6	11.2	7.1
No. of buds dead—Feb.	5	1	11
No. of inflorescences—Feb.	13	23	4
Time when leaves subtending inflorescences became functional	Apr. to Oct.	Dec. to Nov.	Aug. to Sept.

Table 3.—Record of inflorescence differentiation in Deglet Noor palms

Date Defoliated 1947	Inflorescence Production: Defoliated		Partially Defoliated..a		Control	
	47b	48c	47b	48c	47b	48c
July 11	8	0	..	..	9	13
July 22	8	0	4	0	9	10
Aug. 13	9	0	6	1	7	7
Aug. 26	6	0	5	0	5	8
Sept. 24	9	0	..	..	9	12
Oct. 27	7	0	..	..	5	5
Nov. 17	7	6	..	..	4	6

a. All leaves removed excepting the one subtended uppermost 1947 bunch.

b. Number of bunches on palms when defoliated.

c. Number of spadices which opened in the spring of 1948.

(C) three palms had all but six leaves removed in April and all the bunches were left on. A control palm (A) was dissected on May 7 and one palm from each treatment was dissected in mid-July, mid-September and mid-February.

The February dissection revealed that the control palm differentiated 13 inflorescences, whereas the defruited and defoliated palms differentiated 23 and 4 inflorescences respectively, thus showing that leaf fruit ratio during the current year influence the number of inflorescences which differentiate (Table 2). Furthermore, defoliation combined with heavy fruiting (C) restricted the number and size of the leaves which subsequently developed and reduced the rate of growth of the buds.

Observations on the apical sections of the buds from control palms (A) showed that starch accumulates in the buds between July and September. Older buds which fail to differentiate, and the younger buds in the axils of leaves centrad of the spike leaf, fail to accumulate appreciable amounts of starch. On defruited palms (B) all buds subtended by mature functional leaves accumulated large quantities of starch; whereas all buds on defoliated palms (C) contained relatively small quantities. It was noted in Table 2 that on defoliated palms the only buds which differentiated were subtended by leaves which became functional in August and September. These leaves were in a mid position on the palm between the shoot apex and the fruiting bunches. It may be postulated that the carbohydrate needs of the growing point and the ripening fruit are first satisfied. A surplus is required to provide for the differentiation of buds.

To determine if some factor other than starch was involved, a second experiment with Deglet Noor palms was conducted at the U. S. Date Garden at Indio in 1947. Nine 13 year old fruiting Deglet Noor palms were completely defoliated and defruited and the growing portion covered with a black hood. Three palms were partially defoliated by leaving one leaf subtending the uppermost bunch of dates on each palm. Inflorescence development in 1948 shows that removing all leaves between July 11 and October 27 prevented inflorescence differentiation. By leaving one leaf on the palm on August 13 an inflorescence was caused to differentiate (Table 3).

It may be concluded from these tests that: First, sufficient carbohydrates must be available in the palm after the requirements for fruiting and growth have been satisfied to allow starch to accumulate in the buds. Second, after sufficient starch is provided a factor elaborated by the leaves in late October or early November "triggers" bud differentiation at this time. This factor is translocated from the leaf to the buds in the axils of adjacent leaves.

DIFFERENTIATION OF THE AXILLARY BUD AS AN OFFSHOOT

Because offshoots were not found in the dissection of any large fruiting palms, studies were made on commercial size offshoots (30-100 lbs.) and on the small offshots present on them. Since three generations of offshoots are involved, to avoid confusion the commercial offshoots dissected are designated as young palms.

The record of bud differentiation in four of the young palms is set forth in Table 4. Buds were found to differentiate into offshoots (O), inflorescences (I) and a small elongated spadix like structure devoid of floral parts (X). Living undifferentiated buds (BU) and buds which die without differentiation (BD) are also present. The more normal differentiation processes observed in nine of the 23 offshoots studied are illustrated by young palm A. Offshoots differentiate from a series of very small buds subtended by small slowly enlarging leaves which are only 1-2½ inches in length and separated from the shoot apex by only 12-26 smaller leaves. Between the series of offshoots the buds usually differentiate into long thin narrow spadix like structures which normally die before emerging above the fiber sheath of the leaf. Variations from this pattern are illustrated by young

Table 4.—Record of bud differentiation in young palms

A. Deglet Seed.		B. Deglet Seed.		C. High. Khad.		D. Sayer Off.	
No.	Cond.	No.	Cond.	No.	Cond.	No.	Cond.
8	BU	4	BU	4	BU	4	BU
7	0.5	3	BU	3	0.6	3	BU
2	0.5	2	BU	2	BU	2	BU
1	BU	1	BU	1	BU	1	BU
Spike	BU		BU		BU		BU
A1	X	A1	X	A1	BU	A1	O |01
A2	X	A6	X	A2	BU	A2	O .03
A3	X	A7	1 '48	A3	BU	A3	O .05
A11	X	A8	O 2.2	A4	I '47	A4	Lost
A12	O 17	A9	O 2.2	A5	I '47	A5	O 1.5
A13	O 20	A10	O 1.7	A6	I '47	A6	O .5
A14	O 3	A11	O 1.7	A7	I '47		
A15	O 17	A12	X	A8	BD		
A16	O 29	A13	OI '47	A9	BD		
A17	O188	A14	X	A10	BD		

BU—undifferentiated bud; BD—dead bud; O—offshoot, length in centimeter; I—inflorescence, year flower opened; X—spadix without floral parts; OI—bud differentiated as off shoot then changed to inflorescence.

palms B, C and D. In young palm D, buds subtended by leaves A13 and A14 first differentiated as offshoots, then the shoot apex of the offshoot differentiated as an inflorescence producing an elongated fruiting arm with a few spikes upon which unpollenated fruits were present. After a series of normal offshoots a normal inflorescence is present. Young palm C developed about five feet above the ground just below the green leaves on the parent Khadrawi palm. Buds in the axils of the 4-7th leaves produced by this young palm differentiated into inflorescences. The 7th bud above them, however, differentiated into a normal offshoot. Young palm D was a small offshoot on a young Sayer palm. The first six buds produced on this young palm all differentiated as offshoots.

DEVELOPMENT AND ANATOMY OF A YOUNG OFFSHOOT

From the positions of the offshoots found in the young palms it appears that offshoots differentiate from a series of buds which are from 18 to 30 months old and are separated from the shoot apex by about 15 to 18 younger buds.

The offshoot apparently grows slowly for about 10-15 months after it differentiates while its subtending leaf enlarges slowly and elongates rapidly. After the pinnae on the subtending leaf unfold and it becomes functional the offshoot grows rapidly. Anatomical studies reveal that during differentiation two bracts with fiber sheaths which encircle the offshoot differentiate opposite each other on the lateral edges of the bud. Their development is arrested and they are not present on the mature offshoot. The apical meristem of the bud becomes the shoot apex. The initial leaf differentiation consists of two primary leaves which differentiate on the lateral edges of the bud adjacent to the bracts. The fiber sheaths of these leaves may be incomplete, common or complete. A short stalk like stem then developes at the base of the leaves to form the "neck" connecting the offshoot with the parent. Leaf and bud differentiation then occur according to the 5/13 phyllotaxy of the mature palm, although they are somewhat misshapen and out of place because of the constriction by the encircling leaf of the parent palm. Procambial vascular strands differentiate upward into the offshoot from the older strands in the bud.

DISCUSSION

It may be postulated that the differentiation of axillary buds into vegetative parts (offshoots) or floral parts (inflorescences) is determined by two substances. The substance which produces vegetative differentiation (presumed to be an auxin) is present in the shoot apex where it is associated with leaf differentiation. Thus, offshoot differentiation occurs only in young buds subtended by immature leaves situated near the shoot apex. The cyclic differentiation of offshoots from a series of buds indicates that possibly in the late winter the vegetative substance is increased above the requirements of the shoot apex and translocated to a group of buds of the proper age for differentiation.

The floral inducing substance is produced by the photosynthetically active leaf in response to a difinite photo-period. It is translocated to the buds where it induces floral differentiation. This substance not only provides for the differentiation of the bud subtended by the leaf but appears to be produced in excess and translocated to other buds on the palm. Thus, high offshoots on mature palms differentiated inflorescences early in their life as occurred in young palm C, and a young offshoot was influenced so that the shoot apex differentiated floral parts illustrated on young palm B.

SUMMARY

1. The axillary bud differentiates in the axil of the leaf when it emerges from the shoot apex and develops from the meristematic fiber sheath of the younger leaf adjacent to it.

2. Offshoot differentiation normally occurs only on young palms. A series of buds subtended by small slowly enlarging leaves about two years old differentiate simultaneously probably in the spring. Development is slow until the pinnae of the subtending leaf unfold and become functional.

3. Soon after functional leaves are present on a young offshoot the buds between the offshoot series differentiate into modified fibrus spadix like structures which soon die.

4. Inflorescence differentiation normally occurs on mature fruiting palms between October 20 and November 2 simultaneously in a series of buds subtended by 4-5 year old leaves which became functional during the preceding seven months. The number which differentiate is influenced by the accumulation of carbohydrates in the palm between June and October which in turn is influenced by the leaf-fruit ratio at that time. A floral factor elaborated in late October appears to "trigger" the differentiation of inflorescences.

5 Spadix growth is slow between November 2 and February 1, and rapid in February, March and April. Inflorescence spikes differentiate first in November, followed by the elongation of the axis during December, and the differentiation of the flower parts in January.

AN INVESTIGATION OF THE RELATION OF FREQUENCY OF PICKING DEGLET NOOR DATES TO GRADES, PICKING COSTS, AND RETURNS

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U. S. Date Garden, Indio, California

It has been generally supposed by date growers and packers that the decline in quality of Deglet Noor dates that has occurred in recent years resulted in part, at least, from the rather general decrease in frequency of picking as the palms got taller and labor costs increased. In an attempt to find out how important this factor is, a harvesting experiment was started in 1950 on a block of Deglet Noor palms just coming into full bearing (age 7-10 years). The soil on which these palms are planted is classed as Indio loam. It is underlaid at 4 to 6 feet by sand, but is considered too heavy to be a good soil for the variety Deglet Noor. During the period of the experiment, 1950 to 1953 inclusive, it was not fertilized. In 1953, to prevent infestation of the fruit by insects, all bunches were dusted with malathion about three weeks before harvesting began. The annual application of irrigation water amounted to about 7 or 8 acre-feet per acre. The palms were allowed to carry practically all the bunches they produced, and usually only small or faulty bunches were removed. Bunch thinning was moderate and treatment of the palms was uniform except for the frequency of picking the fruit in the different picking treatments.

These treatments varied in the different years. In 1950 and 1953 the treatments were: (1) one pick, (2) two picks, and (3) four picks. In 1951 and 1952 the treatments were: (1) two picks, and (2) four picks. When more than one pick was made in a season, an effort was made to

make the different picks of about the same size, but because of variations in weather conditions and other difficulties there was appreciable variation in this respect. Each year bunch counts on each tree were made, and each replication of treatments was made up of trees with the same number of bunches. The number of bunches per palm was adjusted in some instances by removing a bunch or two of green fruit. The number of trees in the experiment varied in the different years from 60 to 69.

The picking was paid for by the hour and was done by a small select crew so as to obtain uniformity in rate of work. The cost of picking varied from $0.85 to $1.10 per hour during the four-year period.

Since the returns received for the crop were based upon the grades of the door-samples taken by the packing house, these grades were used in this report.

The returns per pound received for fruit of the various grades in each year of the test are shown in table 1. It may be seen that these returns reflect the very poor crop years of 1951 and 1952. In table 2 the percentages of the crop in the various grades in each treatment in each year of the experiment are shown. It is apparent that in 1950, 1951 and 1952 practically no "fancy" grade fruit was produced and the proportion of "choice" grade was rather low, especially in 1952. In 1953 the quality of the fruit produced was much better than in the previous three years, but the door-grades were changed so that a reliable comparison with previous years is not possible. The striking feature of table 2, however, is the surprisingly small effect that picking four times as compared with twice or even once had on the grades. Probably the greatest improvement in grades from picking four times rather than once or twice occurred, however, in 1953, the year of highest quality fruit.

It seems apparent that the principal reason that frequent picking produced little improvement in grades was that, in general, the quality of the fruit produced on this block of trees was very poor, and picking the fruit frequently so that a large part of it would be picked at relatively high moisture content shifted only a small part of it into higher grades. Obviously other factors of importance besides moisture content determined the quality of this fruit. The consequences of producing fruit of fundamentally poor quality are seen in table 3. In this table the returns per average pound of fruit from each treatment, the cost per pound for picking, and the net returns per pound from each treatment are shown. In each year except 1950 the highest net

Table 1.—Returns (cents) per pound for the different grades of dates by years[1]

Grade	1950	1951	1952	1953
Fancy	28.30	35.51	14.48	11.03
Choice natural	10.69	8.13	4.86	
Choice dry	10.63	6.67	4.50	
Select natural				8.92
Semi-dry				8.75
Standard natural	8.85	5.93	4.50	
Standard dry	8.79	4.69	4.34	6.88
Substandard*	—1.06	—2.06	—0.25	—0.63
Cull*	—1.81	—1.39	—0.23	0.0

1. Grades were not exactly the same in 1953 as in previous years
*A minus sign indicates a charge for handling.

Table 2—Percentage of date crop in each grade by years[1]

Grade	1950 For indicated pick			1951 For indicated pick		1952 For indicated pick		1953 For indicated pick		
	1	2	4	2	4	2	4	1	2	4
Fancy	0.0	0.0	0.0	0.0	0.9	0.0	0.0	4.0	3.8	10.7
Choice natural	10.6	8.5	13.6	16.8	10.2	1.0	5.3			
Choice dry	34.0	45.0	36.3	14.9	10.9	16.5	26.1			
Select natural								17.0	12.5	18.4
Semi-dry								28.0	40.9	43.6
Standard natural	6.2	0.0	12.5	10.2	11.2	6.1	13.0			
Standard dry	32.4	39.0	31.1	42.1	50.8	65.6	44.9	44.0	35.0	22.1
Substandard	10.0	2.0	4.3	10.0	6.8	8.5	4.2	6.0	6.8	2.4
Cull	6.9	5.5	2.2	6.1	9.3	2.2	6.5	1.0	1.0	1.6

1. Grades were not exactly the same in 1953 as in previous years.

Table 3.—Picking costs and returns received per average pound of dates from each treatment by years (cents)

Year and Number of picks	Picking cost per pound	Average gross returns per pound	Average net return per pound
1950:			
One	7.90	0.79	7.11
Two	9.00	0.92	8.08
Four	9.06	1.37	7.69
1951:			
Two	4.65	1.32	3.33
Four	4.63	1.99	2.64
1952:			
Two	3.88	1.50	2.38
Four	3.94	2.02	1.92
1953:			
One	7.40	1.05	6.35
Two	7.48	1.67	5.81
Four	8.14	2.31	5.83

return per pound was received for fruit from the plots that were picked least often, that is, those which were picked either once or twice. This is true because frequent picking did not result in the production of an appreciable amount of fancy-grade fruit, the only grade for which premium prices were paid, and did not greatly increase the proportion of choice grade. Furthermore, the differences in the returns for choice and standard grades were usually not enough to compensate for the added cost of frequent picking.

Each of the harvesting seasons involved in this study was relatively free from periods of damaging rain and high humidity, so that it is quiet possible that in years of more than average rainfall during the harvesting season it would be good economy, even with relatively low-quality fruit, to harvest several times during the season. In some gardens the harvesting practice is such that little or no saving would be made by reducing the number of picks to only one or two per season. It would seem, however, that in dry seasons and in periods of high labor costs and little price differential between grades appreciable additional expense for frequent picking would be justified only for fruit of high quality.

THE CONTROL OF DATE BEETLES BY EYE GNAT LARVACIDES

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Manager and District Entomologist

Coachella Valley Mosquito Abatement District

Man's efforts to control the hordes of pestiferous eye gnats in Coachella Valley have been a long one. Studies commenced about 1926, and for the period 1928-1935 four entomologists labored to find a control at the Coachella lab, but without success. Trapping followed from 1936 to 1948 in an effort to reduce the vast swarms. In 1948 efforts to control gnats by adulticides were initiated by the Bureau of Vector Control and finally abandoned as hopeless and economically impossible in September, 1950.

In the fall of 1950 chemical irrigation, that is, running the chemical into the irrigation water, gave the first possible glimmer of long-hoped-for control.

Chemical irrigation was succeeded by soil larvaciding, which overcame some of the bad features of chemical irrigation. In soil larvaciding the operator sprays the chemical insecticide onto the soil surface at a uniform rate of so many pounds of actual chemical per acre. The grower follows immediately behind the spray machine disking the chemical rapidly into the soil to prevent disintegration of the chemical by the hot soil surfaces of Coachella Valley, particularly in the summer months.

In 1951, in the High School area, approximately $5,000.00 worth of chemicals was applied in both emulsifiable and wettable powder forms. The chemicals were: Aldrin, Benzene Hexachloride, Chlordane, DDT, Dieldrin and Heptachlor. All chemicals were applied at the rate of 2 to 3 lbs. of the actual chemical per acre except DDT which was applied at rates of 8 to 22 lbs per acre. By November, four to six months after larvaciding, entomological evaluation indicated that:

1. Emulsifiable concentrates were superior to the wettable powders and much more cheaply applied. Wettable powders constantly gummed up the spray booms and the filters on the spray machines causing much loss of time.
2. Aldrin appeared to give the better control based on this short preliminary period.

The great mass of larvacided date and citrus orchards became known as the General Series. Six large orchards, specially selected and located throughout the valley became known as the Special Series. In these, three different chemicals with a check were repeated in replicated series throughout the orchard. Four orchards were in Aldrin, BHC and DDT., and two in Chlordane, Dieldrin and Heptachlor.

In 1952, on the basis of our 1951 findings, approximately $12,000 worth of Aldrin was applied in the Indio region. In 1953, we endeavored to larvacide all the cultivated date and citrus gardens in Coachella Valley other than those of the high school and Indio regions treated in 1951 and 1952, respectively. The cost of the chemicals, chiefly Aldrin, totaled approximately $20,000.00.

At the end of 18 and 28 months of entomological evaluation we find that Aldrin and Heptachlor were in first place, giving 94 to 95% control of eye gnats. DDT gave 93% but the amount, 8—22 lb per acre, put the cost of larvaciding rather high. Dieldrin and Chlordane rated 90 and 89 percent control, respectively, while BHC gave an unsatisfactory control of only 34%.

In the entomological evaluation of these chemical larvacides a record is kept of all insects emerging from one square yard of soil covered by the emergence trap. These emergence traps are three feet square and one foot deep and covered with black rondo cloth which is topped with canvas. Two quart jars on opposite sides collect all insects coming out of the soil. Escape is prevented by fine mesh copper screen cones in the mouths of the jars. Count of all gnats is accurately made, but large numbers of insects, such as date beetles of the genus *Carpophilus,* are recorded only approximately as to numbers.

At the end of six months we had the following approximate figures for date beetle control:

Aldrin — 87 trap resets permitted 300 date beetles to emerge.

BHC—87 trap resets allowed 2100 beetles to survive.

DDT — 91 trap resets permitted 1200 beetles to emerge.

Checks — 79 trap resets allowed 3600 date beetles to emerge.

It is apparent that Aldrin gave the best control for the six months' period which is approximately 89 to 90%.

At the end of 18 months the accuracy of our results had been increased by the larger number of trap resettings. On the other hand reduction in control is largely due to the deterioration of the chemical in the soil. The figures at the end of 18 months were:

Aldrin—259 trap resets permitted 500 date beetles to emerge.

BHC—280 trap resets allowed 2400 beetles to emerge.

DDT—239 trap resets permitted 2500 beetles to survive.

Checks — 235 trap resets allowed 4100 beetles to develope.

The control of date beetles after 18 months is still the best by Aldrin. The control rate has dropped from 89 to 90% to approximately 83 percent. With BHC the control dropped from 55% after 6 months to 41% at the end of 18 months and for DDT the control dropped from 66% to approximately 38% after 18 months. The results for the other three chemicals have been rendered uncertain by the low "check" figures.

At the end of 28 months our records read approximately as follows:

Aldrin—306 trap resets produced approximately 1100 beetles.

BHC — 318 trap resets produced approximately 4100 beetles.

DDT — 284 trap resets produced approximately 5300 beetles.

An examination of these figures, as illustrated by Graph No. 1, indicates that Aldrin still provides approximately 80% control of date beetles after 28 months. For BHC the control has dropped from 41% to approximately 20% and for DDT from 38 to approximately 4%.

The figures for the other three chemicals are as follows:

Dieldrin — 126 trap resents produced approximately 500 beetles.

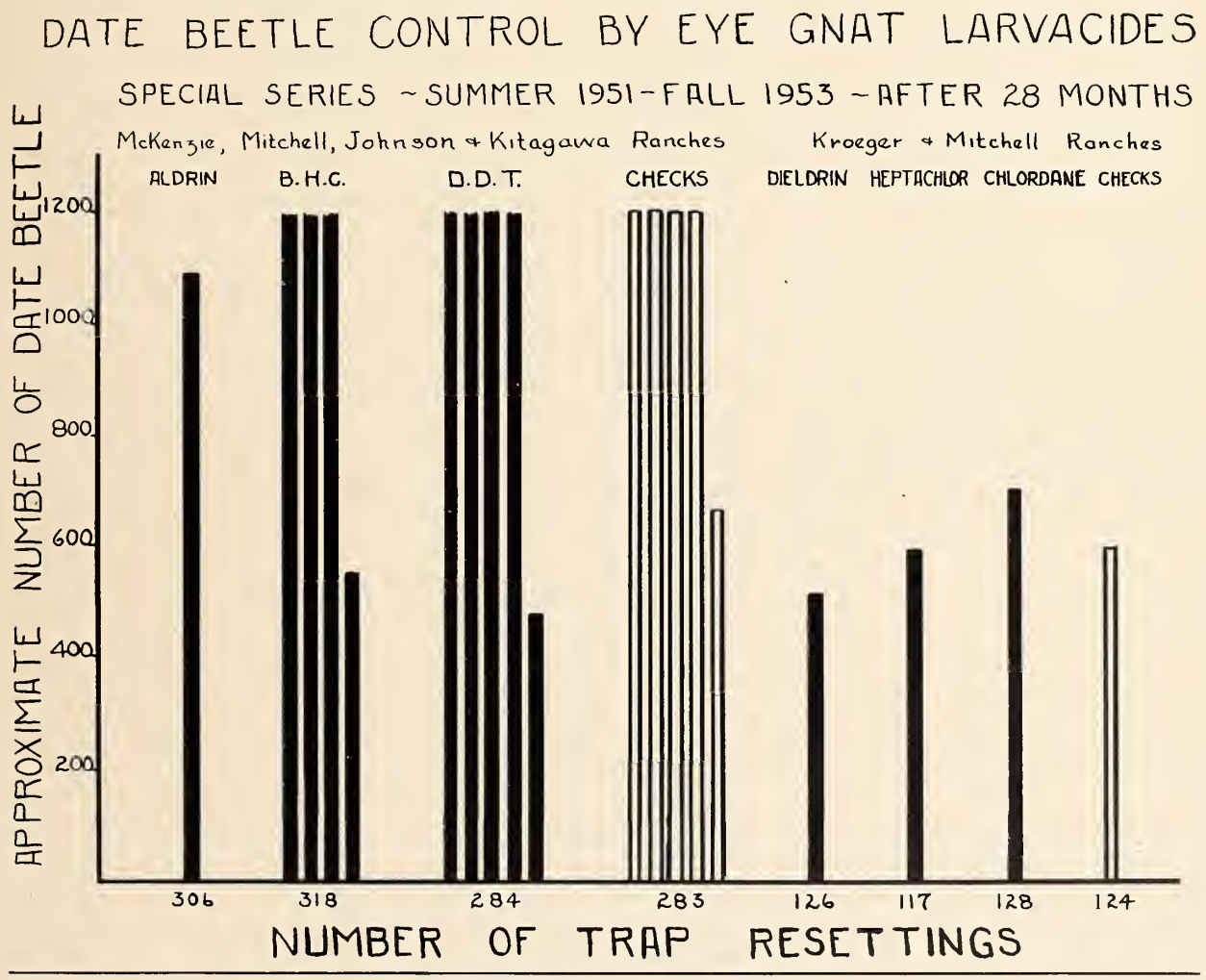
Heptachlor—117 trap resets produced approximately 600 beetles.

Chlordane—128 trap resents produced approximately 700 beetles.

Checks—124 trap resets produced approximately 600 beetles.

Unfortunately the low check figures produced uncertain results for these three chemicals. We believe that Dieldrin and Heptachlor should provide approximately the same control as Aldrin at the same application rates. For Chlordane the application rate should be twice the recommended rate for Aldrin which is three pounds per acre.

In conclusion we can say that the valley-wide larvaciding of all cultivated date and citrus gardens for Eye Gnat Control has unquestionably reduced date beetle populations in the orchards and has aided the growers in reducing date infestations resulting from date beetle attack. This statement is supported by the personal report of a number of date growers in the valley who have noted reduction in date infestations since 1951.



CANNED SIEVED DATES

W. V. Cruess

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At two previous institutes we have reported on experiments conducted on date products in the Food Technology Department of the University of California. At this, the 31st institute, we shall report briefly on what we believe is an improved sieved canned date product. The procedure of preparation and canning is simple and can be conducted with existing standard cannery equipment.

The product consists of a blend of light sugar syrup and sieved dates. In our experiments dates pitted by Elliott pitter at the Associated Date Growers plant in Indio, were used; the pitted dates were employed instead of the whole unpitted because we do not have a tomato pulper. We used instead a laboratory size continuous American Utensil Company fruit and tomato sieving machine consisting of a conical stainless steel screen inside of which revolves a conical screw.

We found that the dates could be sieved much more easily and completely if steamed until scalding hot before sieving. A screen with approximately .04 inch circular holes was used. This screened out a large proportion of the stone cells as well as skin and fiber.

The sieved date was mixed with several different ratios of sugar syrups ranging from 20° Brix to 65° Brix (20-65 per cent sugar). The purpose was to find a combination of syrup and sieved fruit that would give a blend of proper consistency for use in soda fountains, that is one that would not be so dense and stiff that it would be difficult to measure and transfer with a large spoon or soda fountain scoop. On the other hand, it must not be too thin in consistency or dilute in flavor. Blends of 60-65° Brix syrup and sieved date were too stiff and heavy. Best results as judged by the laboratory staff were obtained by blending equal parts by weight of 20-30° Brix cane or beet sugar syrup and sieved date. This mixture is easily spooned but still is not thin or "runny."

Such a mixture will not keep without sterilization by heat in sealed cans or jars, as its soluble solids content is approximately only 45 to 47 per cent. Therefore, canning and sterilization are essential steps, as the sugar content is too low to prevent spoilage.

As the acidity of dates is very low and their natural pH value so high, sterilization by heat would be difficult. Also the low acidity tends to cause milk shakes to be over-sweet. Consequently, the blend in our experiments was lightly acidified with citric acid by adding 0.4 per cent of the acid to the syrup; resulting in an overall increase of 0.2 per cent in the blend, since it consists of equal parts syrup and sieved date. This degree of acidity is low when compared with that of orange juice or of such fruits as apricots and peaches; nevertheless, it is noticeable to the taste and gives milk shakes a pleasing flavor.

The pH value of the blend was found to be 4.26—4.30. With less acid the pH is apt to be too high for safety from spoilage by anaerobic spore bearing bacteria.

Canning and sterilization are the next steps. The blend of sieved fruit and syrup was heated to 200-210° F. and canned scalding hot in small cans (8 oz. or No. 1 tall sizes); sealed at once and sterilized for various periods at 212° F. in boiling water or live steam.

When sterilized for 15-20 minutes the product after sterilization and cooling was of a rather unattractive gray color and low in flavor. Milk shakes made from it were milk-like in color and appearance.

When sterilized 45-60 minutes the product was reddish in color and possessed much more date flavor than that sterilized for 25 minutes or less.

Milk shakes made with the two types of product were sampled by laboratory and office personnel. Majority preference was decidedly in favor of the shake made with the sieved date sterilized for the longer period. A frequent comment was that this product looked much more like dates than did that sterilized for the shorter period.

This product is very satisfactory in puddings, such as those made with ready-mixed preparations containing starch or when used with corn starch; or for use in other types of puddings. It may be used in open face pies thickened with egg or starch; or in making cookie dough, or in certain cake recipes, or with ready-to-serve breakfast cereals, or for cooking with rolled oats or other cooked breakfast cereals, or in whips, or in making date ice cream. Other uses in home recipes and in various commercially baked products are practicable.

A suggested commercial procedure for preparing and canning this sieved date product is as follows: steam the dates until heated through; probably about 6-8 minutes. Pulp them in a tomato pulper with coarse screen. Add an equal weight of 20° Brix cane or beet sugar, syrup acidified with 0.4 per cent citric acid. Mix with heating until smooth and free of lumps. It then is advisable to pass the heated blend through a finisher to make it uniform in texture and to remove coarse particles and some of the stone cells. It is then heated to over 200° F.; canned very hot (190-210° F.); sealed and sterilized for 60 minutes at 212° F. in boiling water or live steam, for No. 1 tall or smaller cans. It is then thoroughly cooled in water; probably not less than 20 minutes, as it cools very slowly because of its fairly thick consistency.

An alternative and possibly more practicable procedure would be the following, because the sieved fruit made by cycloning the heated dates is extremely heavy and stiff. On this account it is difficult to mix it with the syrup. Therefore perhaps the dates should first be heated with an equal weight of water until plump and soft, or heated to boiling and let stand until most of the water is absorbed. Then cyclone the cooked fruit and accompanying "juice"; pass the puree through a finisher; add 0.2 per cent of citric acid and 10-15 per cent by weight of sugar. Heat to 200-212° F.; can hot; seal; and sterilize 60 minutes at 212° F. Cool can at least 20 minutes in cold water. Because of the lack of a tomato pulper this procedure was not tried in our present experiments. However, we did heat dates with an equal weight of water and pulped or "cycloned" them successfully in a small Langsenkamp tomato pulper, three years ago. Therefore, we believe the procedure essentially as outlined above would be feasible and probably more practicable than trying to cyclone dates that had merely been steamed.

Obviously, the next step in this study would be to prepare the canned sieved date product on pilot scale or semi-commercial scale with standard cannery equipment in order to adapt the laboratory results to factory scale production. Also the product should be placed in a few soda fountains, ice cream plants and bakeries, as well as in a sufficient number of representatives homes to determine consumer reaction to its use in milk shakes, ice cream, and bakery products and also in home recipes for puddings, breakfast cereals, cookies and in other dishes.

We believe that these tests should be made in a typical metropolitan area such as Chicago, Los Angeles or New York, rather than in the date producing area in California.

Finally, we also believe that this product has commercial possibilities since it can be made with existing cannery equipment; gives a high yield of finished product per ton of dates and on that account would not be costly; has many uses and possesses a pronounced date flavor and color.

INTRODUCTION

Robert M. Howie

Agricultural Commissioner, Riverside

It is a pleasure to be here and a privilege to act as your Chairman for this afternoon. Although I am a stranger to many of you I am not a stranger to Riverside County or to Coachella Valley. I was employed by the Riverside County Agricultural Commissioner in 1934 and assigned to Coachella Valley to help Harry Bloom inspect vegetables and grapes. The Valley and its problems are familiar to me although I have not had the pleasure of working closely with the date industry at any time.

Having been intimately associated with some of the problems of the Agricultural industry of Riverside County as Chief Deputy Agricultural Commissioner for the last twelve years, you can be assured that as your Commissioner, there will be no radical changes in the policies of the Agricultural Department.

During this period of time much concern has been expressed regarding the future of the date industry. In 1920, 304 acres produced 57 tons of dates. By 1930, the industry had grown to 1,673 acres, of which 662 acres were in full bearing. In this year almost 3 million pounds of dates were harvested, returning twenty cents a pound, thus yielding almost $600,000.00. By 1940, 3,014 acres of dates had been planted, of which 2,706 were of bearing age. Although over 4 million pounds were produced, the price had fallen to 5½ cents per pound, returning only slightly over the amount received for less than 1/3 the amount of dates 10 years earlier.

A decade later, in 1950, 4,841 acres were reported, 3,891 of which were bearing. Over 28 million pounds were produced, returning a gross figure of 5¼ million dollars. Although the average price was .19½c per pound, rising costs of production and processing removed most of the profit.

A few acres of trees had been removed by 1953, leaving a planted acreage of 4,767 acres, however, the bearing acreage continued to increase, and, according to the most recent report, stands at 4,596 acres. In 1953, over 313 million pounds were produced, which returned over four million dollars to Coachella Valley.

So we see a constantly increasing production of this crop regardless of the difficult economic conditions affecting it down through the years. In spite of these economic conditions you date growers are contributing from four to five million dollars of new wealth annually to the economy of this Valley.

Undoubtedly such conferences as this Date Institute have uncovered and answered many problems facing the industry and will continue to perform this valuable service for many year to come.

DATE CULTURE IN SAUDI ARABIA

By Roy W. Nixon

U. S. Date Garden, Indio, California

In the spring of 1953 I was asked by the Technical Cooperation Administration (Point IV) to make a study of the date varieties of Saudi Arabia. I was there from July 6 to December 2. Because of the size of the country it was necessary to concentrate on the most important of the three regions where dates are grown—the Eastern Province, which borders the Persian Gulf. This part of Saudi Arabia has become more or less familiar to many Americans during the past two decades because it is here that the Arabian American Oil Co. ("Aramco") operates with headquarters at Dhahran, five miles from the coast. Fram Dhahran as a base I covered the date-growing districts of the Eastern Province in a jeep-station wagon assigned to me for that purpose. My observations on date culture in other parts of Saudi Arabia were limited to a few days in the vicinity of Jidda on the Red Sea, and to two short trips to al-Kharj, near Riyadh, about 250 miles southwest of Dhahran.

In the conduct of these studies I am pleased to acknowledge the friendly interest of H. H. Amir Saud Ibn Abdullah Ibn Jiluwi, Governor of the Eastern Province, H. H. Amir Abdul Muksin Ibn Jiluwi of al-Hasa, and H. E. Shaikh Abdulla Ibn Adwan, Deputy assistant Minister of Finance, Dammam. Other Government representatives, as well as date growers, in the different localities were very cooperative. Officials of Aramco did much to further the investigations by extending the use of their facilities in localities and under climatic conditions where it would otherwise have been very difficult to operate. In this connection, special thanks are due to Wm. Eltiste and J. G. Hamilton of the Arab Industrial Division for assistance in the planning and execution of the project. I am especially indebted to the two agricultural advisors of the Saudi Arabian Government who accompanied me in the field in their respective districts — Ibrahim Husseini in al-Hasa and Ibrahim Hassuneh in the Qatif district.

GEOGRAPHY

The Kingdom of Saudi Arabia occupies about four-fifths of the Arabian Peninsula. The coastal district from Yemen in the extreme south to Oman and Qatar in the east is excluded. This peninsula is the largest in the world; in size it is about equal to the United States east of the Mississippi River; its greatest length is about 1200 miles between latitudes 12° and 32° north, and its average breadth is about 700 miles.

Most of Saudi Arabia is a plateau bordered on the west by a chain of mountains which parallels the Red Sea and is separated from it by a narrow coastal plain, seldom more than 35 miles wide. These mountains, which have some peaks as high as 7000 feet in the north and 12,000 feet in the extreme south, rise abruptly from the west but merge gradually with the plateau on the east. The plateau averages about 4,000 feet high in the west and slopes gradually to the Persian Gulf in the east, broken in between by a few escarpments and secondary mountain ranges. Seen from the air it is mostly an empty, barren waste. The Rub al-Khali, or Empty Quarter, in the south is about the size of the state of Texas, and about four-fifths of it is covered by sand, the largest continuous body of sand in the world, with some dunes as high as 500 feet. The Great Nefud,

another sand dune area in the north, is larger than San Bernardino County, California, or the states of Vermont and New Hampshire combined.

DATE AREAS

It is estimated that dates are grown on about 90 percent of the cultivated land in Saudi Arabia, quite often in combination with other crops which are usually of lesser importance. The palms are scattered within three widely separated areas—Hejaz, Nejd, and the Eastern Province. According to recent estimates (2) there are about 3 million date palms in each of these areas. The plantings of Hejaz are at elevations below 5000 feet, mostly in the valleys and among the foothills of the western mountains; those of Nejd are in scattered oases, mostly in the central part of the peninsula. The Eastern Province is generally rated the most important of the three areas; within it there are two districts where dates are cultivated—al-Hasa and Qatif—and one isolated oasis, Jabrin, where seedling dates are utilized by Bedoin tribes but abandoned and neglected most of the year.

Al-Hasa is the most important district where dates are grown, not only in the Eastern Province, but in all of Saudi Arabia. It is located about 90 miles southwest of Dhahran and 50 miles inland from the Persian Gulf. The date plantings are in a closely associated but somewhat disconnected L-shaped group of oases extending about 11 miles east and 16 miles north from the town of Hofuf. According to recent estimates, there are 27,000 acres of land under cultivation and 1,600,000 date palms in al-Hasa. The average elevation is 500 feet.

Qatif, 35 miles north of Dhahran, is the center of the second most important date-growing district in the Eastern Province. The dates extend in a disconnected series of plantings over a distance of about 30 miles along the coast. Tarut Island, a few miles offshore, from Qatif, is also included in this district. It is estimated that there are 12,000 acres of land under cultivation in the Qatif district and 1,000,000 palms of which about one-third are less than 10 years old. The average elevation is only a few feet above sea level.

No studies were made at Jabrin because its estimated 300,000 palms are uncultivated and mostly seedlings.

CLIMATE

Saudi Arabia is about half in the temperate and half in the torrid zone and the climate is tropical and subtropical. Mostly it is very hot and dry, but along the coast the humidity is high and very oppressive during the warmer months. Rainfall is estimated to vary from about 4 inches in the north to less than 1 inch in the Rub al Khali. There is more in the mountains on the west with perhaps as much as 12 inches in the southern part of the coastal range.

The only climatic data I was able to obtain were a twelve-year record of temperatures and rainfall at Dhahran supplied by R. S. Matthews of the Arabian Research Division of Aramco.

In Table 1 climatic data for critical periods at Dhahran are compared with those for Bahrein Island, about 25 miles off the coast from Dhahran (12); Basra, Iraq; Touggourt, Algeria; and Indio, California (7). There are no date palms at Dhahran, 5 miles from the Persian Gulf, but climatic conditions along the nearby coast might be expected to be intermediate between those of Dhahran and Bahrein Island. In that case maximum temperatures in the coastal district would be near to those of Basra and Indio. Minimum temperatures in January, however, are much higher, as would be expected from the lower latitude and the proximity to the Persian Gulf. Frost has never been recorded at either Dhahran or Bahrein.

Of the 2.1 inches annual rainfall at Dhahran none has been recorded during the critical period for date ripening, July to October inclusive. The annual rainfall at Bahrein is slightly higher, 2.9 inches, but again the July to October period is practically rainless, only 0.01 inch having been recorded in October. It is evident that the coastal (Qatif) district is actually less likely to have fruit damage from rain than the other date-growing localities with which it is compared.

The chief climatic drawback to date culture in the Qatif district is high humidity. There are no records from the Eastern Province, but evidence that the relative humidity is very high may be seen in the presence of the fungus *Graphiola* on the leaves of date palms. Similar conditions, of course, exist on Bahrein Island but not in the other date-growing localities listed in Table 1.

As compared with the Qatif district, the climate of al-Hasa, about 50 miles inland from the coast, is a little drier with probably slightly higher maximum temperatures in summer and somewhat lower temperatures in winter, but there are no weather data for that locality and these conclusions are based on observations of palm and fruit growth and local conditions, all of which indicate that the district is climatically more favorable for date culture. There are said to be occasional frosts.

WATER AND SOILS

Agriculture and the distribution of dates are determined by the availability of water which, of course, in Saudi Arabia is very scarce. Although there are a few springs in the mountains of Hejaz, water in the western and central part of the country is mostly obtained from wells in the *wadis*, or stream beds, which in this desert country are dry most of the year but have more or less subsurface water at varying depths. In the Eastern Province there is artesian water that reaches the surface in two groups of natural springs, one in al-Hasa and the other along the coast in the Qatif district. There are also similar springs on Bahrein Island. The recent extension of plantings along the coast have been made possible by the drilling of artesian wells, 200 to 300 feet deep.

In general this artesian water is of good quality. From analyses made by Aramco, the total salt content appears, in most instances, to range from 2000 to 2500 parts per million. There are relatively high percentages of calcium and sulphate and a low percentage of sodium. In al-Hasa the same water is used several times, the drainage from plantings on one level serving to irrigate those on the next lower level. Of course, the salt content of the water is increased with usage and when the water is applied to the last plantings it may be more than twice as high in total salts as at the beginning, but observations in al-Hasa indicate that it is still satisfactory for date palms.

In al-Hasa and the Qatif district drainage is necessary to prevent for-

Table 1.—Climatic data for critical periods at Dhahran, Saudi Arabia, compared with those of other important date-growing localities

Station	Average Daily Air Temp. (°F.)				Rainfall (inches)		
	No. yrs. record	Maximum May-Oct. incl.	July	Minimum Jan.	No. yrs. record	July-Oct. incl.	Annual
Dhahran, Saudi Arabia	12	104.2	109	52	12	0	2.1
Bahrein Island	12	93.7	97	56	12	0.01	2.9
Basra, Iraq	19	99.4	104.4	43.6	20	0.14	6.42
Touggourt, Algeria	15	96.6	106.3	38.1	16	0.31	2.27
Indio, California	25	99.7	106.5	38.6	53	0.66	3.00

mation of high water tables. In the lower parts of al-Hasa and throughout most of the coastal district the high water tables are a serious problem that has not yet been satisfactorily solved. Along the coast where there is an ample supply of artesian water from wells drilled during the past decade there has been a tendency to over-irrigate and, because of failure to provide control valves, to waste water. This maintains a high water table because drainage is complicated by the low elevation and the close proximity to the Gulf. In many gardens along the coast the water table is only 1 or 2 feet deep, sometimes almost at the surface. Even date palms are stunted by such conditions and few other plants can survive.

Sandy loams prevail in al-Hasa with some clay layers often occurring at 18 inches to 4 feet. In general, the soils are permeable and offer no difficulty as to drainage. In the Qatif district the soils are lighter, ranging from sandy loam to almost pure sand and as a consequence they are more porous and not as fertile as the soils of al-Hasa. The percentage of gypsum is usually high.

VARIETIES

There are probably not less than 250 named varieties of dates in Saudi Arabia. More than that number have been reported, but until they have all been studied the varietal status of some of them will be uncertain. In Hejaz, Badawi (1) lists 137 varieties and El-Baker (2) 26. In Nejd, 81 varieties are enumerated in a list (unpublished) obtained from Pere Anastace of the Catholic Church of Bagdad in 1929. El-Baker lists 36 for this province. In the Eastern Province, there are 67 varietties which have been described by the writer (unpublished manuscript) in the first detailed variety study in Saudi Arabia, but a few of them are of questionable status as two or more different dates occur under the same label.

Of the 67 varieties found in the Eastern Province, two, one in al-Hasa (Irzaiz, or Ruzaiz) and one in the Qatif district (Khunayzi), account for not less than two-thirds of all palms. This may be taken as evidence of the antiquity of date culture in this area, which has been attested by other studies (4). Three other varieties (Khalasa, Gharra, and Bukaira) are estimated to represent 15 percent of the palm population. These five leading varieties thus comprise more than 80 percent of the total number of palms in these two districts. Of the other varieties, 16 are fairly common; several of them are recognized as inferior varieties but they are planted as specimens because their season of ripening is earlier or later than that of better varieties and they afford fresh fruit at a season when it would not otherwise be available. With these exceptions, most of the other varieties are rare and no longer being planted. All the varieties of the Eastern Province are soft dates.

Irzaiz (Ruzaiz) is the principal variety grown in al-Hasa. It is a small midseason date, attractive after curing because there is almost no skin separation but many smooth facets between wrinkles. The variety is not exacting as to its requirements and produces large, dependable crops under a wide range of conditions. The fruit is yellow with a little red at the base and a fain touch at the apex, ripening to amber, curing to dark reddish brown; broadly oval, often slightly obovate, in shape.

Khunayzi is the principal variety grown in the Qatif district. It is said to be extensively grown on Bahrein Island and to be found in many localities around the Persian Gulf as well as in Oman. It is a medium-sized, midseason date and occupies a predominant place among date varieties along the coast for several reasons. It grows and produces better than any other variety when there is a very high water table, as is common in this region. It is resistant to high humidity as indicated by the rarity of checking and the infrequency of fruit drop. The fruit has relatively little astringency in the *khalal,* or *busr,* stage and makes better "salooq," or boiled dates, than other varieties grown along the coast. The fruit is deep red, ripening and curing to dark reddish-brown, almost black, with bloom giving a purplish cast; obovate in shape.

Khalasa (Khalas) is the best known variety in the Eastern Province. By consensus of local opinion it is rated as the finest date in this area and through the years it has received lavish praise from visitors (3, 9). About 15 percent of the palms in al-Hasa are said to be of this variety and some are found in the Qatif district and elsewhere around the Persian Gulf. Khalasa was introduced in 1913 into the United States where it has been described (5), but only a few palms are to be found in commercial plantings.

Gharra is widely grown in the Eastern Province. It is estimated to account for probably as much as 6 percent of the palms in the Qatif district and for about half this proportion in al-Hasa. It was introduced into the United States in 1904, under the label of "Khir" and was described under that name (5), as its identity was not known until the present study was made; there are only a few palms, all in the Salt River Valley of Arizona.

Bukaira is a small early-ripening date, popular with natives in the Qatif district because of its good quality and large crops, which under favorable conditions are said to exceed those of other commercial varieties.

Tayyar in al-Hasa and *Maji* along the coast are the earliest varieties in their respective districts and a single palm will often be planted because it provides fresh fruit as early as the middle of June, but both are mediocre dates and they are abandoned for better varieties as soon as these are available.

Khisab (Khisab Asfur) is the latest-ripening variety in the Eastern Province and at least one palm will be found in many gardens. The medium-sized fruit is mediocre in quality and not adapted to curing, but it finds ready acceptance and is in demand because it provides large crops of fresh fruit beyond the season of all other varieties, sometimes being held on the palms until February of the next year. Specimens of Khisab were introduced from Iraq into the United States in 1929 and are growing in Government variety collections at Indio, Calif., and Weslaco and Winter Haven, Texas (5).

CULTURAL PRACTICES

Offshoot Handling: In the Eastern Province offshoots are planted from late February to April and from late August through September. Spring planting is preferred if water is plentiful, otherwise early fall planting is considered better. Offshoots in Saudi Arabia are cut with an iron chisel, 4 to 5 feet long with a narrow blade beveled on both sides. This chisel is operated by one man, who thrusts it forcefully by hand between the offshoot and the trunk of the parent palm. An experienced operator can do a very good job, but it takes considerable time to learn to direct the blows with accuracy and there is the ever-present temptation to do more prying and pulling than cutting, which often results in injury to the offshoots. One gardener near Qatif reported that of 209 offshoots planted in his garden, 15 died because of injury in cutting. For protection against sun, wind, and cold during the first year, all offshoots are wrapped with palm fiber at time of planting.

Palm Spacing: Most palms are planted 16 to 22 feet apart each way, some closer, few farther. A distance of 22 feet may provide sufficient space if the growth is stunted by a very high water table or other unfavorable conditions, but in good soil the palms are obviously crowded. In addition, citrus and other fruit trees are sometimes interplanted, but growth and production of the interplantings in such cases are invariably very poor.

An exception is the so-called "dowahi," or border, method extensively used in al-Hasa. Usually two rows of dates, with an irrigation or drainage ditch often between, are planted around plots of varying size in which rice and occasionally other crops are grown. With this arrangement palms spaced 16 to 22 feet within the rows appear to give satisfactory results; the distance between the two rows is somewhat less, or about 10 to 16 feet. Palms in one row are often placed opposite the midpoints between palms in the other row. The best dates seen in al-Hasa were grown in these "dowahi" plantings, and the crops interplanted have adequate sunlight for satisfactory growth and production. This method of interplanting with dates is used successfully in Tunisia and other countries (8).

Irrigation and Drainage: Under practically all conditions in Saudi Arabia surface irrigation is necessary for maximum growth and production of date palms. Water is usually applied in basins that may not occupy more than one-half to two-thirds of the area on which palms are planted. The frequency of irrigation varies with the soil and the availability of water. When the supply is adequate, water is seldom applied at intervals of less than 7 to 14 days in summer and 20 to 30 days in winter. When the supply is more than ample, as in many gardens in the Qatif district, water may be applied as often as every third day in summer and every ten days in winter. This is probably oftener than is necessary, or even desirable in most cases, because of high water tables, as previously mentioned. In al-Hasa, the best gardens are irrigated at intervals of a week or ten days in summer, but in winter, when water is no longer needed for the extensively grown rice, some gardens are irrigated at more frequent intervals. Whether this increased use of water in winter is beneficial is uncertain.

Drainage is provided by ditches spaced at intervals of 50 to 100 feet or even more, depending on the soil, palm spacing, other crops planted, etc.

Fertilization: Animal manures are widely used in Saudi Arabia. The frequency of application varies from one to three years depending on the locality, soil, and economic condition of the garden owner. Applications are more frequent in the better gardens and on the lighter soils. From 3 to 5 donkey loads per palm are commonly applied sometime after harvest. The manner of application varies in different localities. In the Qatif district the fertilizer is placed in the bottom of the irrigation basins which are cultivated before application and stirred afterward to insure mixing with the soil. In al-Hasa fertilizer is applied in shallow trenches, 3 to 6 feet wide, usually near and encircling the palm. In al-Hasa the ashes of dried rushes and other similar materials, which are brought into the garden and burned beneath a layer of soil, are added to the manure. The manures which I saw in the Eastern Province were generally of very poor quality, being mixed with a large proportion of soil and trash.

Cover crops are not grown for their green manure value. Alfalfa is often grown between young palms, but it is cut for stock food and not turned under. Palms are usually so closely spaced that after they come into full bearing no cover crop can be grown because of dense shade.

Cultivation: Cultivation in the date gardens of the Eastern Province is commonly restricted to that involved in weed eradication or the application of manure and is done at intervals of 2 or 3 years. Cultivation for interplantings is done as the particular crop may require. All cultivation in the Eastern Province is by hand. Plows are used to some extent in Nejd and Hejaz.

Pruning: The only pruning is the removal of dead leaves which are cut at any convenient time, usually after harvest in the Eastern Province. The leaf bases are not cut at the same time and occasionally may be left indefinitely, but the usual practice is to cut them for fuel in January or February.

Pollination: In pollination two or more strands from a freshly opened male inflorescence are inserted among the strands of the female cluster, usually after they are shaken over it. Growers in Saudi Arabia believe that different varieties vary in the amount of pollen required and prescribe varying numbers of male strands for pollinating certain varieties in the various date-growing districts.

After a bunch is pollinated, it is the practice in the Eastern Province to wrap it with fiber from the palm trunk. This fiber, tied with a strip from a leaflet, is left on for 3 to 6 weeks; its use is said to afford protection against cold, locusts, birds, and rats, but in the interior province of Nejd, where the nights are colder than in the Eastern Province, one informant said that the wraps are only for protection from cold and that they are used only in the early part of the season.

Fruit Thinning: Fruit thinning in the Eastern Province is confined to reducing the number of bunches to not exceeding 12 for vigorous palms in full production. In a few localities in other parts of Saudi Arabia heavy bunches of some varieties are said to be thinned by cutting entire strands from the center, when the total number is large, and by reducing the number of dates per strand, when the strands are very long, either by cutting back the tips of the strands or by picking off some of the green fruits when they are small.

Pulling Down and Supporting the Bunches: After the pollination season and when the dates begin to increase rapidly in size the bunches are usually pulled down through the leaves. A large bunch may be placed over one of the lower leaves for support, or it may be suspended beneath by tying it to the midrib.

FRUIT HANDLING

Harvesting: The season during which dates ripen in the Eastern Province extends from the middle of June to February. The bulk of the crop that is dried and stored or packed for year-round consumption is harvested from the middle of August to the middle of October, but by use of earlier and later varieties fresh fruit is available for about 8 months. As it begins to ripen fresh fruit is picked in trays or shallow baskets and is sold for immediate consumption as it comes from the palms. Fruit to be packed or stored is left to cure on the palm and then the entire bunch is cut. The fruit is shaken into a large basket carried up the palm by the tree climber and lowered to the ground with a rope. Sometimes the bunch itself is lowered with a large wooden hook attached to a rope, or in some cases, especially with relatively low palms or very dry fruit, the bunch may be dropped on a mat spread on the ground below. If the fruit is sufficiently dry, it may be stored or packed after removal of culls. If it is not already dried to raisin-like consistency, the fruit is spread on mats to dry in the sun for five to ten days as may be required. This supplementary drying is usually necessary for the two principal varieties grown in the Eastern Province — Irzaiz (Ruzaiz) and Khunayzi. Most of the cured dates are packed tightly in large palm-leaf baskets known as "gullahs"; the standard size weighs either 32 or 64 kilos. Dates are also packed in gasoline tins and tanned skins.

Boiling and Drying Dates: About the middle of August, while the fruit is still in the khalal (busr) stage, part of the crop of some varieties is harvested, boiled, and dried. Khunayzi was the only variety I saw handled in this way in 1953, but in times past some of Irzaiz (Ruzaiz) and a few others have also been similarly marketed. In this procedure the entire bunch is cut; the dates are stripped from the strands by pulling the bunch over a large coarse comb with prongs made of date leaf midribs; the fruit is dumped into a large

kettle of boiling water and stirred continuously for a few minutes (7 when I watched the operation), then scooped out with an implement resembling a fisherman's landing net and spread out on the ground in a thin layer to dry. After about ten days the fruit is ready to be packed in bags of various kinds. Dates treated in this way are small, shrivelled, and hard, and are called "salooq." Most of the fruit is shipped to India.

PESTS AND DISEASES

The pests and diseases of dates in Saudi Arabia have not been carefully studied. No doubt there are some besides those mentioned in this section that are of importance. In the Eastern Province, however, none appears at present to be very serious as far as the industry as a whole is concerned, although in some gardens and in some years there is trouble enough to justify investigations along this line.

The migratory locust (*Schistocerca gregaria* Forsk.) may do considerable damage to date palms in some localities in occasional years. I saw such damage for the first time in Wadi Fatima near Jidda. Palms in a few gardens and in exposed locations had in some instances been almost completely defoliated and presented a weird appearance with pinnae reduced to ragged stubs along the midribs. Only a very slight amount of similar damage was seen in the Eastern Province.

Parlatoria date scale (*Parlatoria blanchardii* [Targ.]) was never seen in abundance; it appears to be kept fairly well in check by its natural insect enemies throughout the Eastern Province. It is said to cause occasional damage in the interior of Saudi Arabia and J. G. Hamilton, agricultural consultant for Aramco reported that he had seen severely infested palms treated by removing all the leaves, putting dry straw in the axils of the leaf stubs, and burning the palms.

Two different scales, not previously reported on dates, so far as I know, were seen in Saudi Arabia. One was found on a few specimens of fruit in both al-Hasa and the Qatif district. Infestations were rare and light and it seems likely that this is a scale that prefers other hosts and occurs only incidentally on dates. It was identified by Dr. Harold Morrison, of the Entomology Research Branch, of the U. S. Department of Agriculture, as *Aonidiella orientalis* (Newst.). The other scale was found on date leaves at al-Kharj and was identified by Miss Louise M. Russel of the same Branch, as *Asterolecanium phoenicis* Ramachandra Rao. A few palms were badly infested, but no other infestations were seen and further observations will be needed to determine the economic importance of the scale.

Date mite (*Paratetranychus afrasiaticus* McGregor) is widespread but no appreciable damage was seen except in a few, relatively dry, exposed locations. It does not thrive under the humid conditions along the coast.

"Hasfaf" (drying) and "humaira" (reddening) are Arabic terms descriptive of the appearance of young dates that drop during the period from pollination to early summer. Excessive drop sometimes results in serious loss and has been associated with damage by the larvae of the "lesser date moth" (*Batrachedra amydraula* Meyr.), which feed upon the young fruits. The practice of wrapping the inflorescences after pollination, as practiced in the Eastern Province, is believed by growers to afford some protection.

Ephestia cautella (Wlkr.), a near relative of the fig moth and very similar in habit, is said to be a serious pest in stored dates.

Nitidulid beetles were occasionally found in dates ripening in dense shade.

A large beetle (probably *Pseudophilus testaceus* Gahan) is sometimes abundant enough in the Eastern Province to riddle the trunk of occasional palms with its borings. Most damage was observed in neglected or abandoned gardens and in outlying locations.

Fruit checking was frequently observed, especially in the center of close plantings, but none of the varieties extensively grown develops the blacknose typical of the Deglet Noor variety.

Graphiola leaf spot, or false smut, caused by *Graphiola phoenicis* (Moug.) Poit., occurs on palms along the coast, but only within very close plantings are infections occasionally severe enough to cause some reduction in leaf surface. The fungus is probably held in check to a large extent by the periodic occurrence of hot, dry winds from the interior desert areas.

Black scorch, caused by *Thielaviopsis paradoxa* (De Seyn.) Hoehn, was seen on an occasional palm, but here, as in other parts of the date world, the disease is of sporadic occurrence and seldom the cause of appreciable loss.

"Al-Wijam" disease is a name given to a decline of date palms in the Eastern Province of Saudi Arabia. The visible symptoms are stunted growth, reduced fruiting, and eventual death of the palm. In the Qatif district, decline that appears to be caused by a very high water table or unfavorable soil conditions is called "Al-Wijam." In al-Hasa, the name is applied to a decline that may occur in gardens where conditions are favorable for palm growth. Here, in addition to reduced growth and yields, there is one symptom that suggests a virus disease: on the midribs of the younger leaves, as seen from the outer side, there is usually a faint, narrow, yellow, longitudinal line. Although losses have occurred in a few gardens, at present the disease is apparently of minor economic importance.

PROBLEMS

Drainage: Drainage is the most serious problem in the Eastern Province of Saudi Arabia, especially in the coastal district. The situation is likely to become worse unless steps are taken to correct it in the near future. Water already too high in most of the date gardens, becomes still higher because of inadequate drainage and, in many instances, excessive irrigation. Meanwhile, some plantings on higher ground suffer for the lack of water which might be provided if its present usage could be conserved and if lifts or pumps could be installed. In this event some additional land might be brought under cultivation. Engineers have already made some study of the problem and pointed to its solution (10, 11). Deeper drainage ditches are badly needed. Main ditches providing outlets to the Gulf should have automatic control gates which will prevent high tides from entering but will not prevent the outgo of drainage water at low tide. Irrigation practices should be such that waste water will be held at a minimum and the maximum use is made of drainage water. The most urgent need for the immediate future is a survey of water resources, water tables, and possible land utilization as a basis for an over-all, comprehensive drainage program.

Economic Decline: An increasing number of date gardens in the Eastern Province are being neglected and in some instances entirely abandoned. Those that I saw were in most instances on land too high for gravity water and the cost of water lift may have made the difference between profit and loss. The reason for neglect or abandonment most commonly given was increased cost of production. Labor is said now to cost 2 or 3 times what it did 10 years ago. Meanwhile, according to data provided by authorities at Hofuf, date production in al-Hasa has declined from 128,950 mauns (63,632,250 lbs.) in 1945 to 70,900 mauns (35,095,500 lbs.) in 1953, a decrease of 45 percent. The situation has not been adequately studied.

Wider Utilization of Available Knowledges I was impressed in

Saudi Arabia by the vast amount of valuable experience and knowledge which has been acquired by individual date growers but is largely ignored by others. Most of the cultural practices that have been rediscovered by experience and experimentation in California during the last half century (6) have long been used in some localities and by some individuals in some parts of Saudi Arabia. Fruit thinning on the bunch, which has been thoroughly demonstrated in California to improve the size and quality of dates, is said ot be practiced with some varieties in Nesheem and Medina, but it is not done elsewhere. The superiority of the border, or "dowahi," system of interplanting dates with other crops has been demonstrated in al-Hasa, but many interplantings continue to be made both there and in the Qatif district with dates alternating with fruit trees in plantings too close for dates alone so that the shaded crop is almost worthless. After 40 years of experience in California growers are finally beginning to realize that for best results, when fruit trees or any other crops are interplanted with dates, the plantings must be arranged so that each crop gets its quota of sunlight and can be given some differential cultivation if necessary.

In this connection, the many fine varieties of dates in Saudi Arabia should be mentioned. These varieties, however, are for the most part different in the different districts and oases, for they have been developed locally over a long period. It is entirely possible that one or more of the better varieties now grown only in one part of Saudi Arabia may be better adapted for planting in other districts than those already established.

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QUALITY OF DATES IN SOME AMERICAN MARKETS

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In November and December 1953 dates, mostly American-grown, were obtained in some of the larger markets in midwestern and eastern United States for a study of their quality. They were obtained mainly from retail stores, for small lots were not ordinarily available at the wholesale level. The purpose of this study was to obtain information on the quality of the dates as they are offered for sale to consumers.

The nature of the examination given the dates limited the number of samples that could be handled in the time available, and the number examined was consequently smaller than desired. The samples were purchased in any stores where dates could be found and there was no selection of samples except to avoid undue replication of any brand or quality in any one market.

DESCRIPTION OF SAMPLES

The samples were examined for moisture content, pH, color, flavor, odor, spoilage, texture, syrupiness, and general appearance. Moisture was measured indirectly by use of sugar-content readings with a hand refractometer and was recorded to the nearest one-half percent. Measurements of pH were made with a glass-electrode meter. Color was rated according to an arbitrary scale in which the most desirable color for the variety was given a value of 2 and the darkest, least desirable color —2. Dates having the darkest color that was presumed to be acceptable to the consumer was rated 0. Those with color intermediate between 2 and 0 were rated 1, and those with color intermediate between 0 and —2 were rated —1. In a like manner dates with the finest flavor characteristic of the variety were rated 2, those with a slight but detectable characteristic flavor were rated 1, those that were sweet but had no noticeable date character and yet were not off-flavored were rated 0, those with a slight off-flavor were rated —1, and those with a distinct off-flavor from fermentation, from aging, or from very noticeable overheating in hydration, were rated —2. A similar scale was used in rating odor. Dates with a noticeable aroma characteristic of the variety were rated 2, those with a slight but detectable date odor were rated 1, those with no noticeable odor were rated 0, those with a slight off-odor were rated —1 and those with a distinct off-odor were rated —2. Spoilage was recorded as being due to mold, fermentation, or age. Where the texture deviated markedly from a desirable one it was described briefly. Nearly all the samples were of the Deglet Noor variety, as to be expected since most American-grown dates are of this variety.

A sample consisted of one package of dates packed in consumer packages and of one-half pound of bulk dates. The size of sample therefore ranged from 7¼ ounces to 3 pounds. One to five fruits per sample were selected so as to represent the extremes as well as the intermediate qualities of the lot. These were examined indi-

vidually for moisture content and pH and the values reported are those of individual fruits. The other properties were recorded for the sample as a whole. Excessively hard- and soft-textured fruits were usually recorded as fractions of the number of fruits in the sample.

The samples were often examined on the day they were obtained at the markets. If they were held until the following day they were usually placed in a refrigerator. In Chicago, New York, and Washington the samples were seldom held more than 1 day before examination. In Florida the samples had to be carried from Miami, Fort Myers, and Tampa to Orlando, and a delay of 1 to 3 days occurred between purchase and examination.

FINDINGS

INTERVIEWS

The principal complaint of brokers on date quality was the presence of old fruit on the market. The main reason given for this is that shippers or buyers hold the fruit until the beginning of the season after it is grown and then place it on the market as the new crop begins to move. Sometimes the seller only implies that such dates are new-crop ones and sometimes he actually claims that they are. Had these dates been stored at temperatures appropriate for long-time storage from the time they were harvested, their quality might have been acceptable provided it was good originally. However, this practice evidently had not been followed because these old dates were often dark, of poor flavor, and of poor texture.

One of the serious complaints of brokers and wholesalers was the price structure maintained by the date industry. This aspect was not investigated in this survey. It appears, however, that this phase of the problem is of sufficient importance to warrant serious study.

Buyers complained only occasionally of spoilage. This does not mean that California dates are not rather perishable. Most buyers had found from sad experience that it is desirable to purchase small quantities of dates and move them fast enough to dispose of them before they have time to spoil. One large chain store buyer had reduced the purchase of California dates to nearly zero because of spoilage experienced in the past. Although the shipper replaced spoiled packages, this buyer would rather omit domestic dates from his purchases than endure the inconvenience and expense of registering complaints and making adjustments. Most often the buyer absorbed the loss and said nothing about it. This type of reaction has resulted in the loss of many sales and the shippers may not have been aware of the basic reason.

Reports of spoilage were more numerous at Florida markets than at those farther north. Appreciable loss in sales was indicated as a result of lack of confidence in the produce as well as from spoilage itself. Adjustments were difficult to make because of the requirement that spoiled packages be retained until the periodic visit of the shipper's representative. These visits were rather widely spaced and in the meantime the spoiled dates occupied valuable space and contaminated the warehouse. Consequently, the buyer often discarded the spoiled packages and absorbed the loss.

The opinion has long been expressed in the Coachella Valley that eastern consumers prefer hydrated (dry dates that have moisture added) to natural or nonhydrated dates. The reason for this preference given by one buyer was that hydrated dates are less likely to spoil than natural ones and the preference of the consumer is based on this difference rather than on the flavor or texture of hydrated dates. Experiments reported at the Date Growers' Institute in 1953 (2) support this difference in perishability. The obvious conclusion is that eastern buyers frequently receive dates with too high moisture content when they purchase nonhydrated dates. Consequently, this type of date has developed a reputation of being a poor keeper, and in spite of its possible finer eating quality it is more profitable for a dealer to offer sound dates of somewhat inferior flavor and possible inferior appearance than to offer dates of potentially superior quality that may have a tendency to spoil. The alternative to lowering the moisture content of these perishable dates is to hold them under constant refrigeration and apparently the marketing agencies do not fully recognize the necessity for this.

The recently adopted practice of using a volatile fungicide in the packages has undoubtedly prevented much spoilage from mold and fermentation. Good results are dependent upon a suitable dosage, tightly sealed packages, and impervious packaging material but failures occur too frequently to be ignored. When moist dates are packed and one or more of the above requirements is not met spoilage may result. Even one fruit with high moisture content in a package may cause spoilage, as equalization of moisture among dates within a package is slow. Even though dates with a high moisture content may be protected from mold and fermentation by the application of volatile fungicides, they remain subject to deterioration from darkening and loss of flavor.

EXAMINATION OF SAMPLES

Receivers complained of poor grading and failure of the dates received to have the quality displayed by the shipper in the sales sample. Inspection of samples purchased at random at the markets substantiated the claim of poor grading.

Tables 1 to 4 give the condition of the 71 samples examined. Of these 71 samples, 65 were American-grown dates purchased at the markets, 4 (lots Nos. 2 to 5 inclusive) were imported dates, and 2 (lots 26 and 27) were American-grown dates that were several years old and had been stored in refrigerated warehouse from the time they arrived. These 2 samples were from small lots that had been overlooked by the owners and were obtained from the warehouse operator. They were examined to learn the condition of dates of such age after storage under conditions considered to be excellent for holding dates up to perhaps 1 year.

Table 1.—Condition of dates found on markets in Chicago, Illinois, November, 1953

Lot No. and variety	Crop year	Hydration[1]	Color[2]	Flavor[3]	Odor[4]	Amount of or reason for spoilage or deterioration	Percent of moisture and pH of fruit No.[5] 1	2	3	4	5	Remarks[6]
1 (Deglet Noor)	1953	+	1	1	1	0	(28.0	28.0	27.0	24.0	20.5)	Many with hard centers,
							(5.9	6.0	5.9	5.6	5.4)	some too soft.
2 (Imported[7])	[8]	+	1	0	0	0	(16.5				)	Slight graininess.
							(5.2				)	
3 (Imported[7])	[8]	+	1	0	0	0	(18.5	18.0			)	
							(4.6	5.2			)	
4 (Imported[7])	[8]	+	1	0	0	0	(16.5	16.0			)	
							(5.1	4.9			)	
5 (Imported[7])	[8]	+	0	0	0	0	(16.0				)	Package attractive outside;
							(5.1				)	contents unattractive.
6 (Deglet Noor)	1953	—	2	2	2	0	(30.5	30.0	27.5	27.5	24.0)	Quality excelent but fruits
							(6.3	6.1	6.1	5.8	5.8)	variable and perishable.
7 (Deglet Noor)	1953	+	1	2	1	0	(26.0	25.5	25.5	23.0	22.5)	Last 3 unsatisfactory; 7 of
							(6.3	6.3	5.8	5.2	5.4)	40 fruits too hard.
8 (Deglet Noor)	1953	+	1	1	0	0	(25.0	23.5	22.5	22.5	22.5)	Quality
							(5.3	5.2	5.6	5.3	5.4)	indifferent.
9 (Deglet Noor)	1953	+	0	1	1	0	(27.0	26.0	24.0		)	Some were
							(5.5	5.7	5.2		)	rubbery.
10 (Deglet Noor)	1953	+	1	1	1	0	(26.0	24.0	23.0		)	
							(6.1	5.5	5.8		)	
11 (Deglet Noor)	1953	—	2	2	2	0	(28.5	27.5	27.0		)	Quality excellent,
							(6.4	6.5	6.6		)	moisture slightly high.
12 (Deglet Noor)	1953	+	1	1	0	0	(22.0	20.0	18.5		)	
							(5.7	5.4	5.6		)	
13 (Deglet Noor)	1952	+	—1	0	0	0	(21.5	21.5	19.5		)	Dark, unattractive, reddish;
							(5.2	5.1	5.2		)	flavor of overheating.
14 (Deglet Noor)	1952	+	0	0	0	0	(16.0	15.5			)	
							(5.2	5.2			)	
15 (Deglet Noor)	[8]	+	—2	—2	—2	Age	(20.5	19.5			)	Very dark; strong flavor
							(4.8	4.9			)	and odor; in glass jar.
16 (Deglet Noor)	1952	+	—2	—1	0	Age	(16.5	16.5	15.0		)	Dark, puffy, wrinkled,
							(5.3	5.1	5.0		)	broken skins, dry, hard.
17 (Khadrawy)	1953	+	0	1	0	0	(23.5	22.5	22.0		)	
							(5.5	5.5	5.4		)	
18 (Deglet Noor)	1953	+	1	1	1	0	(23.0	21.0	20.0	20.0	19.5)	Extremely variable; No. 1
							(5.8	5.2	5.6	5.1	5.1)	O.K. others too hard.
19 (Deglet Noor)	1952	+	0	0	0	Age	(18.0	16.5	14.0	13.5	13.5)	Too hard; some crystallized
							(5.7	5.7	5.6	5.5	5.4)	sugar.

1—+, hydrated dates; —, natural, or nonhydrated, dates.

2—2, most desirable color; 1, slightly darker than 2; 0, darkest color that was presumed to be readily acceptable to the consumer; —1, somewhat darker than 0; —2, the darkest, least desirable color.

3—2, fine flavor characteristic of variety; 1, slight but detectable characteristic flavor; 0, sweet without characteristic flavor; —1, slight off-flavored; —2, decided off-flavor.

4—2, pronounced aroma characteristic of variety; 1, slight aroma characteristic of variety; 0, without noticeable odor; —1 slight off-odor; —2 decided off-odor, usually from fermentation or mold.

5—Upper value for each fruit is the moisture percent and the lower one pH.

6—The ordinal numbers are the same as those under "Percent moisture and pH of fruit No."

7—Variety not certain.

8—Crop year not known, but dates old.

Table 2.—Condition of dates found on markets in New York, N.Y., and vicinity, November, 1953

Lot No. and variety	Crop year	Hydration[1]	Color[2]	Flavor[3]	Odor[1]	Amount of or reason for spoilage or deterioration	Percent of moisture and pH of fruit No.[5] 1	2	3	4	5	Remarks[6]
20 (Deglet Noor)	1953	+	1	1	1	0	(27.5	26.0	26.0	25.5	23.0)	Highly variable; No. 1 & No.
							(5.5	5.4	5.1	5.1	5.0)	2 good; Nos. 3 to 5 rubbery.
21 (Deglet Noor)	1953	+	1	2	1	0	(31.5	29.5	29.0	24.0	22.0)	Irregular; some fruits too
							(6.5	6.5	6.0	5.7	5.7)	soft.
22 (Halawy)	1953	+	1	1	1	0	(23.0	22.5	22.0	22.0	20.5)	Most fruits too hard.
							(5.5	5.5	5.8	5.3	5.4)	
23 (Deglet Noor)	1953	+	1	1	0	0	(26.5	25.0	22.5	22.0	21.5)	Frass in 1 fruit; 3 of 20 fruits
							(6.0	5.7	5.3	5.7	5.4)	too hard; Nos. 3 to 5 were too hard.
24 (Halawy)	1953	+	1	1	0	0	(23.0	22.5	22.5	21.0	21.0)	10 of 24 fruits, including
							(5.6	5.5	5.3	5.6	5.7)	Nos. 2, 3, & 5 were too hard.
25 (Deglet Noor)	1953	—	2	2	2	0	(26.0	25.5	23.0	23.0	22.5)	Quality excellent.
							(6.0	5.6	5.8	5.7	5.8)	
26 Deglet Noor)	1949	+	—2	—1	0	Age	(20.5				)	Dark and off-flavored;
							(5.7				)	abandoned in storage.
27 (Deglet Noor)	1950	—	—1	—1	0	Age	(20.5				)	Dark, poor flavor;
							(5.9				)	abandoned in storage.
28 (Deglet Noor)	1953	—	2	2	2	0	(33.0	32.0	31.0	30.5	26.5)	Quality excellent but fruit
							(6.6	6.4	6.5	5.9	6.4)	much too soft.
29 (Deglet Noor)	1952	+	—1	—1	0	Age	(26.5	24.0	24.0	23.0	22.0)	Dark, poor flavor, grainy,
							(5.2	5.1	4.9	5.3	5.4)	coarse.
30 Deglet Noor)	1952	+	—1	—1	0	Age	(25.5	24.5	24.0	23.5	23.5)	Dark, poor flavor; some
							(5.4	5.3	5.1	5.2	5.1)	fruits too hard.
31 (Deglet Noor)	1952	+	0	0	—1	Age	(26.0	24.0	24.0	23.0	22.5)	Small; frass in 1 fruit; 8 of
							(5.5	5.5	5.3	5.0	5.3)	22 fruits were too hard; Nos. 3 to 5 were too hard.
32 (Deglet Noor)	1953	+	1	1	0	0	(27.0	26.5	26.0	25.5	24.0)	3 of 20 fruits too hard, 4 too
							(5.7	5.7	5.4	5.3	5.4)	soft; Nos. 3 to 5 too hard, No. 1 & No. 2 too soft.
33 (Deglet Noor)	1952	+	—1	0	0	Age	(24.0	22.5			)	Dark, lacking in date flavor.
							(5.3	5.3			)	
34 (Deglet Noor)	1952	+	—2	0	0	Age	(28.0	27.0			)	Dark, little flavor, very
							(5.2	5.3			)	soft.
35 (Deglet Noor)	1953	+	1	0	0	0	(25.5	25.0	24.5	23.5	21.0)	13 of 38 fruits were too hard;
							(5.5	5.4	5.6	5.3	5.2)	overheated in hydration.
36 (Deglet Noor)	1952	+	—1	0	0	Age	(19.0	18.0			)	Many torn skins;
							(5.4	5.6			)	unattractive.
37 (Deglet Noor)	1953	+	1	1	0	Fermented	(31.0	25.3	23.0	22.0	)	4 of 20 fruits too hard, 6
							(5.4	5.4	5.2	5.2	)	too soft; No. 1 fermented, No. 3 & No. 4 too hard.
38 (Deglet Noor)	1953	+	1	1	0	0	(25.5	24.5	24.0	23.5	)	5 of 23 fruits were rubbery;
							(5.8	5.3	5.3	5.2	)	No. 1 & No. 2 O.K.; No. 3 & No. 4 rubbery.
39 (Deglet Noor)	[7]	+	—2	—1	0	Age	(19.0	18.0			)	Dark, poor flavor, grainy;
							(5.4	5.3			)	may be older than 1952.
40 (Deglet Noor)	[7]	+	0	—1	—1	Age	(26.5	22.5	22.0		)	Dark, poor flavor; may be
							(5.4	5.5	5.4		)	older than 1952.
41 (Deglet Noor)	[7]	—	1	1	1	0	(20.0	19.0	18.0	18.0	)	Good color and flavor for its
							(5.5	5.5	5.6	5.6	)	age; sugar crystals in flesh.
42 (Deglet Noor)	[7]	+	—1	—2 to 1	—1	Fermented	(26.0	25.5	25.5	23.5	22.5)	
							(5.7	6.2	5.9	6.1	5.9)	Sugar crystals.

Table 2 — (Continued)

1—+, hydrated dates; —, natural, or nonhydrated, dates.

2—2, most desirable color; 1, slightly darker than 2; 0, darkest color that was presumed to be readily acceptable to the consumer; —1, somewhat darker than 0; —2, the darkest, least desirable color.

3—2, fine flavor characteristic of variety; 1, slight but detectable characteristic flavor; 0, sweet without characteristic flavor; —1 slight off-flavor; —2 decided off-flavor.

4—2, pronounced aroma characteristic of variety; 1, slight aroma characteristic of variety; 0, without noticeable odor; —1 slight off-odor; —2 decided off-odor, usually from fermentation or mold.

5—Upper value for each fruit is the moisture percent and the lower one pH.

6—The ordinal numbers are the same as those under "Percent moisture and pH of fruit No."

7—Crop year not known, but dates old.

Table 3.—Condition of dates found on the markets in Washington, D. C., and vicinity, December, 1953

Lot No. and variety	Crop year	Hydration[1]	Color[2]	Flavor[3]	Odor[4]	Amount of or reason for spoilage or deterioration	Percent of moisture and pH of fruit No.[5] 1	2	3	4	5	Remarks[6]
43 (Deglet Noor)	[7]	+	—1	1	0	0	(23.5	23.0	22.0		)	Dark; sugar granules
							(6.1	6.1	6.2		)	
44 (Deglet Noor)	1953	+	1	2	1	0	(31.5	26.5	26.0	24.0	21.5)	Some crushed fruits; No. 4 & No. 5 incompletely broken down.
							(6.0	5.8	5.8	5.5	5.5)	
45 (Deglet Noor)	1953	+	0	1	1	0	(30.0	29.0	28.5	28.0	25.5)	10 of 50 fruits were too hard; No. 1 & No. 2 crushed; No. 3 O.K.; Nos. 4 & 5 too hard.
							(6.2	6.2	5.9	5.4	5.5)	
46 (Deglet Noor)	1953	+	1	1	1	0	(26.0	25.0	25.0	24.0	)	
							(6.2	5.9	6.3	5.8	)	
47 (Deglet Noor)	[7]	+	—1	—1	—1	Age	(21.5	21.5			)	Poor flavor; slight off-odor but not fermented.
							(5.4	5.4			)	
48 (Deglet Noor)	1952	+	0	1	0	0	(24.0	22.0	20.5	19.5	)	Rough appearing; 8 of 25 fruits too hard; No. 1 O.K.; No. 2 & No. 4 too hard.
							(6.2	5.8	5.5	5.3	)	
49 (Deglet Noor)	1953	+	0	1	0	0	(25.5	24.0	23.0	22.5	22.0)	6 of 48 fruits were too hard and 8 were crushed; Nos. 1 & 2 crushed; No. 3 O.K.; Nos. 4 & 5 too hard; overheated in hydration.
							(5.6	5.7	5.1	5.3	5.8)	
50 (Deglet Noor)	1952	+	0	0	0	0	(22.5	20.5	20.5	20.0	)	7 of 22 fruits were hard or rubbery; Nos. 1 & 2 O.K.; Nos. 3 & 4 too hard; overheated in hydration.
							(5.5	5.8	5.3	5.2	)	
51 (Deglet Noor)	1952	+	0	0	0	0	(29.0	29.0	25.5	24.5	23.5)	No. 1 dark and poor-flavored; all lacked flavor.
							(5.8	5.4	5.6	5.4	5.5)	
52 (Deglet Noor)	1952	+	—1	—1	0	Age	(24.0	23.0	22.0	21.5	21.5)	5 of 23 fruits were rubbery; No. 1 O.K.; Nos. 3 to 5 rubbery.
							(5.5	5.5	5.3	5.8	5.5)	

1—+, hydrated dates; —, natural, or nonhydrated, dates.

2—2, most desirable color; 1, slightly darker than 2; 0, darkest color that was presumed to be readily acceptable to the consumer; —1, somewhat darker than 0; —2, the darkest, least desirable color.

3—2, fine flavor characteristic of variety; 1, slight but detectable characteristic flavor; 0, sweet without characteristic flavor; —1 slight off-flavor; —2 decided off-flavor.

4—2, pronounced aroma characteristic of variety; 1, slight aroma characteristic of variety; 0, without noticeable odor; —1 slight off-odor; —2 decided off-odor, usually from fermentation or mold.

5—Upper value for each fruit is the moisture percent and the lower one pH.

6—The ordinal numbers are the same as those under "Percent moisture and pH of fruit No."

7—Crop year not known, but dates old.

Table 4.—Condition of dates found on the markets in Florida, December, 1953

Lot No. and variety	Crop year	Hydration[1]	Color[2]	Flavor[3]	Odor[1]	Amount of or reason for spoilage or deterioration	Percent of moisture and pH of fruit No.[5] 1	2	3	4	5	Remarks[6]
53 (Deglet Noor)	[7]	+	0	1	0	Age	(23.5	22.5	22.5		)	Very grainy with sugar crystals.
							(6.0	6.1	5.9		)	
54 (Deglet Noor)	1952	+	0	0	—1	Fermented	(27.5	27.0	26.0	25.5	24.0)	14 of 43 fruits were dry &
							(5.1	5.5	5.2	5.2	4.9)	rubbery, 9 were too soft.
55 (Deglet Noor)	1953	+	0	1	0	0	(28.0	27.5	26.5	26.5	25.0)	
							(5.5	5.5	5.5	5.9	5.6)	
56 (Deglet Noor)	[7]	+	—1	0	0	Age	(22.0	21.0	20.5	20.5	20.0)	
							(5.1	5.1	5.1	5.0	5.1)	
57 (Deglet Noor)	1953	+	0	—2	—2	Fermented	(28.5	27.5	27.0	25.5	24.0)	7 of 41 fruits were rubbery
							(5.7	5.8	5.8	5.1	6.0)	& 17 were too soft; Nos. 1 to 3 fermented; No. 4 rubbery.
58 (Deglet Noor)	1953	+	0	1	0	0	(32.5	31.0	30.0	25.5	24.0)	9 of 41 fruits were rubbery
							(6.0	5.9	6.0	5.5	5.5)	& 17 too soft; No. 4 & No. 5 were rubbery.
59 (Deglet Noor)	1953	+	0	1	0	0	(24.0	23.5	23.0	23.0	22.0)	8 of 23 fruits were rubbery
							(5.7	5.9	5.6	5.2	5.3)	& 4 too soft; No. 4 & No. 5 were rubbery; very poorly graded.
60 (Deglet Noor)	1953	+	0	1	0	0	(28.5	27.5	27.5	27.0	25.5)	2 of 18 fruits were too hard,
							(5.5	5.7	5.6	5.7	5.5)	12 were too soft.
61 [8]	[7]	+	—1	—2	0	Age	(25.5	24.5	24.5		)	Flavor of overheating and
							(4.7	4.7	4.8		)	of age; canned.
62 (Deglet Noor)	1952	+	0	0	0	Age	(25.0	25.0	24.5	23.0	22.5)	12 of 45 fruits were rubbery
							(5.2	5.2	5.2	5.2	5.6)	& 4 too soft; very poorly graded.
63 [8]	[7]	+	—2	—2	—1	Age	(25.0	24.0	24.0		)	Flavor of overheating; old
							(4.7	4.8	4.8		)	canned.
64 (Deglet Noor)	1953	+	1	2	0	0	(27.0	25.5	25.5	23.0	22.0)	Attractive; canned.
							(6.1	6.1	6.0	5.8	5.7)	
65 (Deglet Noor)	1953	+	1	1	0	0	(28.0	27.5	27.0	27.0	25.5)	2 of 19 fruits were too hard
							(5.5	5.7	5.8	5.5	5.6)	and 11 too soft.
66 (Deglet Noor)	1953	+	0	1	0	0	(24.0	24.0	23.5	23.0	23.0)	8 of 44 fruits were too hard;
							(6.0	5.7	6.0	5.6	5.4)	No. 4 & No. 5 rubbery; dried after packaging.
67 (Deglet Noor)	1953	+	0	1	0	0	(28.0	28.0	28.0	28.0	27.5)	3 of 20 fruits were hard and
							(5.5	5.2	5.3	5.2	5.7)	rubbery & 13 too soft; lot inclined to crush.
68 (Deglet Noor)	1953	+	0	1	0	0	(28.0	26.5	26.0	24.0	23.0)	Flavor of overheating; 3 of
							(5.3	5.2	5.6	5.8	5.3)	19 fruits were too hard & 5 too soft; poorly graded.
69 (Deglet Noor)	1953	+	1	1	1	0	(29.0	28.0	27.0	26.0	25.0)	6 of 128 fruits were too hard
							(5.8	5.7	5.6	6.1	6.0)	and other O.K.; quite uniform; 3-lb. friction-top can.
70 (Deglet Noor)	1952	+	—2	—2	—2	Fermented & molded	(26.0	24.0	23.0	23.0	22.5)	Poor in all respects.
							(4.9	5.1	5.1	5.2	5.1)	
71 (Deglet Noor)	[7]	+	—2	—2	—2	Age	(28.0	27.0	26.0	25.5	25.5)	Flavor of overheating; 4 of
							(4.7	4.6	4.6	4.6	4.6)	43 fruits were rubbery and 7 crushed; canned.

Moisture Content. Much variability in texture or moisture content or both was found in many samples. In 18 of the 65 samples of American dates, or more than one-fourth of those examined, moisture content of individual dates differed by 4½ percent or more, and as much as 10 percent. The range was more than 5 percent in one-eighth of the lots. In 24 samples at least one-seventh of the dates in each package were too hard or rubbery. In one of the samples of Deglet Noor (Lot 59) one-third of the fruits in a half-pound tray were rubbery. In a half-pound package of Halawy (Lot 24) more than two-fifths of the fruits were hard and tough. It is evident that grading such as this is not conducive to increased date purchases. In contrast, the few packages of imported dates examined had uniform moisture contents. The four lots examined had an over-all range of 2½ percent in moisture content and the texture was uniform; furthermore, none of the dates had spoiled. On the other hand, the flavor of these dates did not compare favorably with that of the best domestic dates. The low pH values 4.6 to 5.2 are also indicative of rather low quality.

A moderately high moisture content in dates may not be objectionable if the dates are properly handled and reach the consumer fairly soon after they are packed; in fact many consumers prefer the soft texture of such dates. However, as all date packers and handlers know, the high moisture content that gives the desired texture also increases the perishability. The use of volatile fungicides only partly overcomes this difficulty, and the only sure method of retaining good quality in moist dates is the use of low temperatures. The temperature required depends upon the length of storage. Of the 65 samples of commercial domestic dates examined, 39 contained individual fruits with 25 percent or more moisture. This is equal to 60 percent of the samples examined. Nineteen samples, or 29 percent of those examined, contained fruits with 28 percent or more moisture. The highest moisture content found was 33 percent.

Of the same 65 samples, 21 lots, or 32 percent, contained dates with less than 22 percent moisture; 11 lots, or 17 percent of those examined, contained dates with less than 20 percent moisture. Dates that are too dry have an objectionably hard texture. To have a desirable texture the Deglet Noor needs a higher moisture content than such varieties as the Halawy. Deglet Noor dates with moisture content below about 22 percent usually need to be hydrated, and hydration often improves those with a moisture content somewhat higher. Texture is rather closely associated with moisture content, but differences in the nature of the flesh sometimes upsets this relation. Dates with naturally low pH values (relatively high acidity) usually have a harder texture than those with high pH values, and the same moisture content. Dates with pH values of 6.0 or above are almost certain to have excellent flavor. Unless dates are held at low temperature the pH value decreases rapidly even in the absence of ordinary forms of spoilage such as fermentation or molding. The cause of this change has not been determined. The use of volatile fungicide does not retard it.

In relating carefulness of grading to specific packing houses it became clear that most shippers of bulk and film-packaged dates on occasion sent poorly graded dates to the markets. On the other hand, overheating in hydration appeared to be restricted to a few. Eight packages, or 12 percent of those examined, showed evidence of overheating.

Imported Dates. The uniformity and reliability of the imported dates are important factors in their competition with the domestic product. The price difference is probably not important, as the price per pound of imported dates covered about the same range as that of domestic dates. On the markets visited, the price of domestic dates ranged from 27½ to 60 cents per pound; one-half-pound units were usually priced at 19 to 25 cents each and pound or larger units at 30 to 40 cents per pound. The fact that the imported dates were pitted whereas nearly all the domestic dates found on the markets were whole makes an accurate price comparison difficult. A 7¼ ounce package of pitted dates corresponds quite closely to an 8-ounce package of whole dates.

Canned Dates: Dates in cans or jars were generally unsatisfactory. An outstanding exeception was dates canned by a method recently developed by the Bureau of Agricultural and Industrial Chemistry (2). So that this product will retain a good reputation on the market its distribution should be controlled so as to eliminate the possibility of holding cans from one season to the next as might be a temptation with this sort of package. Perhaps placing the packing date on the can would be helpful. Some canned dates found at the markets were of other brands and had obviously been held over for one or more years. They were of very inferior quality in color, odor, flavor, and texture, but none had spoiled from molding or fermenting. Dates in cans appeal to the dealers in Florida because the ever-present ants cannot enter cans. These insects are a continuous source of trouble with dates in film packages in that State.

Old-crop Dates. The amount of old-crop dates at the markets can be appreciated from the fact that 28 of 65 samples, or 43 percent of the domestic dates collected, were 1952 crop or older. In a few instances it was difficult to determine whether the sample was an abused lot of current-crop dates or a fairly good-quality carry-over from 1952. The percentage of carry-over dates is extremely high when one considers that this year the old crop was thought by the date industry to have been almost completely disposed of before the beginning of the 1953 harvest. The inferior quality of most of the carry-over stock makes one question the advisability of retaining old dates with which to start the new season. Most buyers probably prefer to wait longer for their order to be filled rather than take old dates and thus demoralize the sales at the outset. This attitude was expressed by some of the brokers. It is recognized that much pressure is exerted early in the season to get dates rolling to the market, but the buyers want new-crop dates, not holdovers. However, the purpose of this investigation was to learn the condition of the dates found at the markets and not to propose methods of merchandising. The problem is how to dispose of an entire crop to the best advantage before the next crop becomes available in a manner that will not allow any of the old crop to appear at any market.

Insect Infestation. The date industry is to be commended for the thoroughness with which it combats insect infestation. Except for the ants mentioned, no live insects and no evidence of live insects were found in any package and no complaint of insects was given by anyone connected with the distribution of dates. One dead beetle was found in a package and frass was found in the seed cavity of two "hidden culls."

SUMMARY

American-grown dates found at midwestern and eastern markets of the United States may be criticized on the following features:

1. Wide range of moisture content of individual dates in single packages.
2. Frequent occurrence of dates with high moisture content and consequent spoilage resulting in lack of confidence in the soundness of the product by potential buyers. This lack of confidence was frequently extended to all brands of American-grown dates even though the unfavorable experience might have been with the product of only one or a few of the shippers.
3. Wide range of texture of individual dates in single packages.
4. Too many old dates at the markets along with new-crop dates.

No evidence of live insect infestation was found. The problem with ants in Florida is no reflection on the packers in the date-producing areas.

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CLEANING DATES IN THE SMALL PACKING HOUSE

Thomas R. Brown
Grower

I have been asked by the program committee to tell how the small packing house meets the problem of cleaning dates in a satisfactory manner. A small scale operation would hardly justify the expense of installing the large type of washer used in large packing houses.

We pack only enough of our crop for a small mail order business and send the rest to a large packing house in Indio. Our date varieties consist of Barhi, Deglet Noor and Medjool.

We at one time packed all our fruit and have retained a shaker-type grading belt used commonly throughout the valley. We find it satisfactory today for the Deglet Noor variety. Only the best fruit is run and that portion considered satisfactory for our market is retained and re-run over wet towels.

The Medjool is a large semi-soft date that develops wrinkles as it ripens. We found dust and insecticides difficult to remove with towels. The problem was finally solved by using compressed air. The fruit is spread one layer deep on trays of hardware cloth, arranged on a rack convenient to the compressor. An engine cleaner "gun" is attached to the air hose and dust is then blown from the fruit. Air pressure of seventy pounds is maintained with continuous running with our compressor. Care needs to be exercised with high pressure as fruit is sometimes damaged. The engine cleaner attachment has a suction hose through which water is drawn when desired, and a fog spray produced. The fruit is gone over a second time with a fog spray. Trays are then stacked and fumigated and the fruit is run over the grading belt for sorting. We found it necessary to remove the sorting frame from the grading belt when running Medjools as the fruit was so large it would mash under the frame.

We have tried the above cleaning procedure with the Barhi and Deglet Noor varieties and have found it successful. If the cleaning could be done on an endless chain belt that would convey fruit directly to the sorting belt much labor would be saved.

PACKING HOUSE EXPERIENCE IN USE OF MALATHION FOR CONTROL OF DRIED FRUIT BEETLE

E. E. Smith
perintendent of Valley Date Gardens, Indio

The 1953-54 season marks the first use of Malathion, on a commercial basis, for the control of the Dried Fruit Beetle on Dates in the Coachella Valley.

For the past several years a good deal of work has been done, on an experimental basis, on this project with results that have indicated that good control can be obtained by proper use of Malathion, even in heavily infested gardens.

The Insecticide Division, U. S. Department of Agriculture has accepted the following label claim for prepared dust:

"For control of Dried Fruit Beetle on Dates, apply 4% or 5% Malathion dust. A thorough coverage should be applied to each cluster. Make no application on Dates within 21 days of first picking."

Beginning the 1953-54 season we applied Malathion to approximately twenty different gardens, using 5% dust applied at from 20 to 40 pounds per acre. The dust cost was about 21c per pound. In most cases regular power dusting equipment was used but in a few cases small hand dusters were employed. Care must be used to get good coverage with a minimum amount of dust loss due to its relative high cost. We believe that date tubes and covers are beneficial in getting good coverage without excessive dust loss, but unbagged gardens appeared to get effective coverage.

Originally there was some question as to the cleaning of the Dates after dusting, but experience indicated that the use of high pressure spray washers left no detectable residue.

Unfortunately for the experiment, but fortunately for the date crop, the past season was one of the lightest infested crops in a number of years. While most treated areas showed infestation of 0 to 2% we cannot deny that there were untreated areas which showed much the same results. Because of this, there can be some disagreement as to the benefit of the use of Malathion. However, after checking through our records as to infestation, I have chosen, for comparison, two acreages which I shall designate as Ranch A and Ranch B.

These gardens were chosen because:

1. They are adjoining
2. They are roughly the same age
3. They are both interplanted to citrus
4. Previous years show about the same infestation count.

Ranch A was dusted in the prescribed manner about three weeks prior to time of picking by the use of power dusting equipment.

Ranch B was not dusted prior to first picking but was dusted after the first picking was completed in each palm, by the use of a hand duster.

Ranch A began picking October 10 and with sixteen deliveries during the month plus one load November 3, showed the following infestation count: 2 2 2 3 1 2 1 1 1 2 2 2 1 2 1 2.

Ranch B began picking October 1 with 18 deliveries up to and including November 5 shows the following count per load: 4 10 4 4 10 10 8 5 9 2 6 4 6 4 2 4 9 5. It should be remembered that this ranch was dusted immediately after the first picking was completed on each individual palm, by use of a hand duster just before the picker left the palm. This, of course, extended the dusting period over a considerable length of time. The interesting thing is that beginning with the first delivery after November 5, which was the last load shown in the figures above for Ranch B, and continuing on to the end of the pick, December 28, the following infestation percentages were noted: 2 3 1 2 2 1 2 1 0 3 2 0. Colder weather may have had some bearing on this reduction but it would appear that the reduction in infestation could be related to the time of completion of Malathion dusting.

Ranch A, however, starting his deliveries after November 5, showed only a slight change in infestation percentages. Beginning November 14 and to completion January 11, fourteen loads were delivered and the following infestation percentages were noted: 1 2 1 0 1 1 1 0 0 1 0 0 0 2.

It would seem that the evidence indicates the effectiveness of Malathion. It also would point up the desirability of application of the dust three weeks prior to time of picking so as to avoid excessive infestation of the early picks, which of course always occurs in the hottest weather when the beetle is most active.

The final proof of the effectiveness of Malathion must await a year when the beetle population reaches an extreme high as it has done in some of the past years.

MALATHION DUST FOR CONTROL OF NITIDULID BEETLES AND PYRALID MOTHS INFESTING DEGLET NOOR AND KHADRAWI DATES IN THE COACHELLA VALLEY

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1. *The writers wish to express their appreciation to various date growers, to packing-house operators, and to the staff of the U. S. Date Garden at Indio for their cooperation.*
2. *Carpophilus dimidiatus* (Fab.), C. *hemipterus* (L.), *Urophorus humeralis* (Fab.), and *Haptoncus luteolus* (Er.).
3. *Ephestia figulilella* Greg . and *Plodia interpunctella* (Hbn.).

Experimental results indicate that malathion is effective in the control of nitidulid beetles[2] and pyralid moths[3] infesting dates when it is applied to the bunch approximately 3 weeks prior to the first picking. A thorough application is required, using approximately 40 pounds per acre of a 4 per cent dust formulation.

Laboratory screening tests in 1951 indicated that malathion was effective at low dosages in killing the adults of the four species of nitidulid beetles infesting dates in the Coachella Valley. Limited field experiments with this compound during the 1951 and 1952 seasons showed enough promise to warrant commercial applications during the 1953 season, results of which are given in this report.

Two Deglet Noor gardens, one in the Indio area and the other in the Thermal area, and a Khadrawi garden in the Indio area were treated each with 2, 3, and 4 per cent malathion dusts at the rate of 40 pounds per acre approximately 3 weeks prior to the first picking. Treatments were applied by means of a rotary hand duster, and all date bunches were thoroughly dusted. The Deglet Noor bunches were covered with paper bags before dusting; the Khadrawi bunches were wrapped with cheesecloth covers immediately after dusting. Dates were picked at 2-week intervals, and both sound and cull fruits were checked for insect infestation and fungus spoilage.

Table 1 gives the results of a 4 per cent malathion dust treatment applied at the rate of approximately 40 pounds per acre 3 weeks prior to the first picking. In the Deglet Noor gardens fruit from the untreated bunches averaged 6 per cent infestation by nitidulids, while fruit from the malathion-treated bunches averaged 0.6 per cent infestation. Moth infestation in these gardens was reduced from 3 per cent in the untreated bunches to less than 0.1 per cent in the malathion-treated bunches. The 3 and 4 per cent dusts were equally effective in control of the nitidulid beetles; the 2 per cent dust was less effective. In the Khadrawi garden the fruit from the untreated bunches average 21.2 per cent infestation by nitidulids, whereas fruit from the malathion-treated bunches averaged 0.8 per cent infestation. In this same garden the moth infestation was reduced from 4 per cent in the untreated bunches to 0 per cent in the malathion-treated bunches. In this garden as in the Deglet Noor gardens, the 3 and 4 per cent dusts were equally effective in control of the nitidulid beetles, and the 2 per cent dust was less effective.

Table 1.—Effect of Malathion Dust Treatments on Infestation of Deglet Noor and Khadrawi Dates with Nitidulid Beetles and Pyralid Moths, 1953*

Date garden	Percentage of dates Infested with beetles	Infested with moths	Spoiled by fungus	Beetles present on final examination Alive	Dead
Deglet Noor No. 1					
Treated	0.4	0.0	11.2	0	20
Untreated (control)	3.1	0.8	10.3	11	0
Deglet Noor No. 2					
Treated	0.8	0.1	6.4	13	403
Untreated (control)	9.6	4.9	7.0	1174	0
Khadrawi					
Treated	0.8	0.0	0.4	9	1241
Untreated (control)	21.2	4.0	0.3	4244	0

*A 4 per cent malathion dust formulation was applied to date bunches at the rate of approximately 40 pounds per acre 3 weeks before the first picking.

During the 1953 season some commercial gardens in the Valley were dusted with a 4 per cent malathion dust, as this material has been licensed for use on dates. Over 2,000 of the Deglet Noor dates that were ready to be delivered to the packing-house from these treated gardens were cut and examined, and only 3 insect-infested dates were found. It is not known what the infestation would have been in these same gardens without treatment, since the entire gardens were dusted, but in past years many of these gardens have had insect infestation problems.

Although malathion is relatively nontoxic it is considered a poison, and dates treated with malathion should be washed prior to marketing. Results indicate that the malathion residue present on dates 3 to 4 weeks after treatment ranges from 1 to 1.25 parts per million on unwashed fruit and is less than 1 part per million on washed fruit.

SOME EXPERIENCES WITH DATES AND LIVESTOCK IN COMBINATION

Farm Advisor, Riverside County
Dean D. Halsey

A number of Coachella Valley date growers have at one time or another attempted to grow livestock in combination with the date enterprise. These attempts have had varying degrees of success. Although the number of such combination enterprises is not large at the present time, they do seem of sufficient interest and importance to justify a report at the present meeting. This report is not intended to be an exhaustive treatment of the subject by any means, but simply an account of the experiences of some in the hope this may be useful to others.

The first example is a farm having about forty acres of young dates with alfalfa growing between the rows. Since the owner was engaged in the produce business and had a sizeable quantity of cull dryed beans to dispose of each year, it was hoped that hogs would provide additional income while the date grove was reaching full bearing. Farrowing, brooding and finishing pens made of concrete were built between the rows of dates and the hogs were brought in. As high as 70 sows were kept at one time and the total herd numbered as high as 500. The diet consisted of the alfalfa pasture plus cooked cull dates and beans. The venture was unsuccessful from the first. The manager feels that the diet should have had some animal protein added to it, especially for the farrowing sows. In addition there was a great deal of trouble with diseases. Hog cholera, enteritas, pneumonia and other maladies accounted for many of the young animals so that during the several years of the venture, only two and one-third pigs were marketed per litter. The light sandy soil in this grove was deemed a drawback for the hogs. The young palms were at that time thought to be too small for effective shade which should be at least four feet higher than the standing animal.

An electric fence was used to confine the large animals on pasture, but this was found to be entirely unsatisfactory and there was a great deal of trouble with animals getting out.

As a result of the many difficulties encountered and the absence of any profit from the venture, it was finally abandoned. Holes were bulldozed alongside the concrete pens which were then pushed into the holes and covered up. Considerable damage was done to the young palms by this operation and by the hogs themselves. Young trees both in the farrowing and finishing pens and in the pasture were rooted out and killed. This operator now keeps no livestock on his place.

The second example is much more enthusiastic about the possibilities of livestock. He was given three pigs in 1945 which he raised in among the dates and when grown were butchered and put in the home freezer. The next year he bought eleven more which have by now increased to about a hundred hogs on this 40 acre date garden. The owner raises all his own pigs with litters averaging about eight at each farrowing. He prefers Hampshire-Duroc crossbreds and is at present using a purebred Duroc boar. When the young pigs begin looking too much like pure Durocs he will change to a Hampshire boar.

This farmer estimates it takes seven to eight months to develop a 200 pound animal which is about the desirable weight for marketing. The diet consists of about one-third cull dates. The rest is made up of pasture of peanuts, alfalfa, corn, Bermuda grass or less desirably of Hubam clover. He notes that this latter grows very well under dates, but is not relished by the animals. Self feeders are kept full of a dry ration consisting of ground barley, alfalfa meal or whatever else may be available at the moment to grind and feed. During the winter when feed is short it is necessary to buy commercial hog food. To this grower the hog enterprise has been an excellent means of disposing of cull dates profitably and a source of additional income from the land available.

In the third example to be discussed, hogs have also proven a welcome addition to the date enterprise. This grower was formerly troubled considerably from the date beetle so that he considered it worthwhile to hire his cull dates picked up and disposed of. When he figured up what this was costing him he found he could buy a hog fence for 10 acres for the same amount paid out in one year for picking up the culls. He now turns in the hogs after each picking and finds his beetle problem diminished because of the prompt clean-up of the waste dates.

Large concrete pipes set down around the irrigation valves in this garden provide water for the stock during periods when the irrigation pump is shut off. Winter feed on the place is taken care of by a large quantity of cull sweet corn which is spread out to dry after picking and fed when other feed becomes short. A pecan orchard also provides some good feed after the crop is harvested. The owner with fifty acres of dates, thirty acres of pecans plus several plots of sweet corn feels he should keep about one hundred and fifty hogs in order to be most efficient.

Our fourth example is a high school boy with two FFA livestock projects, one in beef cattle and one in hogs. For the beef project he bought four Black Angus animals at about four months of age weighing four hundred pounds and sold them in eleven months weighing about one thousand pounds. By careful pasture management with frequent rotation of the animals he feels he could get sufficient pasturage under dates to keep one beef animal per acre. Hubam clover, Sudan grass and barley and oats during the winter have given the most forage. Six weeks before the cattle were sold, self feeders were put in the pasture and the animals were finished on cottonseed meal, barley and alfalfa.

With the cattle the cull dates do not intentionally form a part of the ration. The owner notes that cattle will eat dates off the bunches on small palms and will pick up enough culls to make themselves sick. To prevent this he turns hogs in the pasture ahead of the cattle to clean up the fallen dates.

This boy is trying out Hampshire and Berkshire hogs and intends to raise pure-breds finally. He feeds them cull dates, sweet corn and the pasture. He has a plan for a self-waterer with an automatic float valve to put in the pasture. This should simplify the somewhat bothersome chore of keeping water before the animals at all times.

The fifth example had a short experience with sheep which may be of interest to others. A sheep grower contracted to use this date garden for pasturing his flock. 1500 head were turned into the garden and in one day had grazed off about five and one half acres of weeds, much to the satisfaction of the farmer. However, the second day the herdman noticed the sheep were picking up cull dates around the base of the palms. That night one of them died and the next morning several were ill. Most of the flock had developed a diarrhea by the third day and two more died the next night. By holding the animals to only the area where they had already grazed it was possible to hold the sickness in check, but at the end of a week there had been no weight gain whatever so the herdsman took the sheep out. Weed growth had been very well cleaned up in the area grazed with a considerable saving in weed oil. Next year the owner ex-

pects to clean up the cull dates by some means and try the same thing again.

Dr. Hoadley, the local veterinarian explains that the difficulty encountered with these sheep is the typical response to be expected when a ruminant animal eats too much of a high sugar substance such as dates. Sugar is converted to alcohol by the bacteria in the paunch of the animal with alcohol poisoning resulting. The dates seeds usually create no difficulty.

The last example to be discussed uses sheep and geese with the dates, not so much to gain extra income as to reduce weed infestation in the date garden and adjoining citrus. A few geese were bought some years ago and they have gradually multiplied. They are reported to live to a ripe old age barring disease or accident so that there is no trouble to keep the desired number on the place. A few birds are killed and dressed for home use. It is necessary to provide grain, ground alfalfa or other suitable feed for the geese during the winter. They need to have water available every five to six hundred feet through the garden in order to get even pasturage of the weeds. This grower has installed a surface pipe watering system.

In addition to the geese twenty-five sheep are kept here on seven acres of dates. The ewes average about one lamb apiece per year which are fattened and killed for the home locker or for sale. The older sheep are sold at about five years of age. All the animals are sheared once a year which brings in additional income from the sale of wool. These sheep pick up dates as they fall in the garden and seem to suffer no ill effects.

Since the main purpose of both sheep and geese on this place is to keep down weeds, the pasturing is handled quite differently than on the other places described. The idea here is to keep the animals on the same pasture until all the weeds are gone. I saw the garden just after the sheep were moved to another area, and there was scarcely a spear of green to be seen where formerly there was a heavy infestation of Bermuda and nut grass. A woven wire fence has been found necessary here to keep out wild dogs and coyotes which will kill both sheep and geese.

In summary perhaps the following points should be made:

1. The cull fruit, pasturage and shade available in a date garden do make it profitable to grow hogs in some cases.

2. The limited pasturage and shade under the palms make it possible to grow cattle. High feed requirement for beef animals will require seeding of carefully chosen pasture plants and rapid rotation of the animals from area to area. Shade of the palms limits tonnage obtainable from such pastures and supplementary feeds may need to be purchased especially during the winter.

3. Sheep and geese can be used to reduce weeds beneath palms. Precautions may have to be taken to keep the sheep from eating too many cull dates at once.

4. Growth of pastures around young palms especially during the summer may compete with the dates for water and nutrients and can cause delay of the palm in coming into full bearing.

5. Any livestock enterprise will require new techniques and present problems which may be new to the date grower. Animals require a more constant attention than most plants. A date grower should approach livestock with caution and preferably on a small scale at first.

Date Growers' Institute - 1954 Membership

Arkell Date Garden . . . . . Indio

Bisbee, Melvin—Hall, Hass & Vassey, Thermal
Blackburn, R. W. . . . . Thermal
Breyer, Alberto . . . . . Argentine
Brown, Thomas R. . . . . Thermal

California Date Growers Assn. . . . . Indio
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Carey, Laura K. . . . . Palm Springs
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Chiles, Austin C. . . . . Los Angeles
Citrus Experiment Station . . . . Riverside
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Clark, G. B. . . . . Indio
Coachella Ranches—D. A. Stevening, Riverside
Coachella Valley Publishing Co. . . . Indio
Codekas, E. J. . . . . Thermal
Conroy, Jessie B. . . . . Indio
Cook, W. W. . . . . Palm Desert
Cosgrove, Robert . . . . . Indio
Crommelin, Marjorie B. . . . . Palm Springs
Cruess, W. V. . . . . Berkeley

Darley, Ellis F. . . . . Riverside
Darnell, W. G. . . . . Brawley
The Dates Officer . . . Berbera, Somaliland
DaVall, E. K. . . . . Cathedral City
Davis, E. Fred . . . . . Los Angeles
Dillman, R. S. . . . . Bard
Dunlap Ranches . . . . . Thermal

Echols Ranch . . . . . Thermal
Embleton, Tom W. . . . . Riverside

Farrar, E. Keith . . . . . Indio
Furr, J. R. . . . . Indio

Gandra, Heloisa . . . . . Sao Paulo, Brazil
George, Frances M. . . . . Indio

Hadayah, Habib W. . . . . Basrah, Iraq
Heiny, Francis . . . . . Brawley
Henderson, Randall—Desert . . Palm Desert
Hilgeman, Robert . . . . . Tempe, Arizona
Hodgson, Robert W. . . . . Los Angeles
Howie, Robert—County Agri. Comm., Riverside

Indio Chamber of Commerce . . . . . Indio

Jaleto Ranch . . . . . Los Angeles
Jarvis, Eugene . . . . . Thermal
Jarvis & Gebhardt . . . . . Thermal
Jenkins, Paul . . . . . Indio
Jenkins, W. G. . . . . Indio
Johnson, Mrs. May . . . . . Bard

Kral, Louis . . . . . Calexico

Leach, George . . . . . Thermal
Lichty, Kenneth . . . . . Indio
Lindgren, David . . . . . Riverside
Longley, Dr. E. G. . . . . Long Beach

Mackenzie, J. F. . . . . Indio
Macpherson, D. F. . . . . Indio
Martin, Martha Reid . . . . Rancho Mirage
McKay, Arthur L. . . . . Indio
Mitchell, Don . . . . . Indio
Mock, D. C. . . . . Redlands
Mrak, Emil M. . . . . Berkeley

Newcomb, D. A. . . . . Thermal
Nixon, Roy . . . . . Indio
Nuttonson, M. Y. . . . . Washington, D. C.

Page, Milton C.—Rancho Palm Springs, Indio
Pinyan, R. A. . . . . Indio

Reichel, William . . . . . Oakland
Reuther, Walter . . . . . Orlando, Florida
Richardson, H. B. . . . . Davis
Richardson, W. L. . . . . Porterville
Russel, Robbins . . . . . Redlands
Rygg, G. L. . . . . Pomona

Scheniman Paper Co. . . . . Indio
Schroeder, C. E. . . . . Los Angeles
Schwabacher, A. E. . . . . San Francisco
Sharples, George C. . . . . Tempe, Arizona
Smead, Paul F. . . . . Thermal
Sphinx Date Co. . . . . Phoenix, Arizona
Stogsdill, Ralph D.—Smith Lithograph Co.
. . . . . Los Angeles
Sunipalms Date Garden . . . . . Indio
Swingle, Leonardt . . . . . Indio
Swingle, Mrs. W. T. . . . Washington, D. C.

Turk, Howard . . . . . Coachella

Venus Foods . . . . . Los Angeles
Vincent Lloyd E. . . . . Riverside

Webb, Robert W., Jr. . . . . Palm Desert
Western Province Fruit Research
Station . . . . . Stellenbosch
Westerfield, John . . . . . Coachella
Wilson, Gynn . . . . . Arcadia
Winsor, Mulford . . . . . Phoenix, Arizona
Wolfe, A. F. . . . . New York
Woodbury, George . . . . . Indio
Wurts, T M.—Vandermaid . . . . . Indio

Yoweil, Hillman . . . . . Indio

Zayit, Moshe . . . . Beisau Valley, Israel